THE INDUSTRIAL REORGANIZATION ACT

HEARINGS

BEFORE THE

SUBCOMMITTEE ON ANTITRUST AND MONOPOLY

OF THE

COMMITTEE ON THE JUDICIARY UNITED STATES SENATE

NINETY-THIRD CONGRESS

SECOND SESSION

ON

S. 1167

PART 7

The Computer Industry

JULY 23-26, 1974

Printed for the use of the Committee on the Judiciary

(Pursuant to S. Res. 255, Sec. 4)

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THE INDUSTRIAL REORGANIZATION ACT (S. 1167)

(The Computer Industry)

TUESDAY, JULY 23, 1974

U.S. Senate,
Subcommittee on Antitrust and Monopoly
of the Committee on the Judiciary,
Washington, D.C.

The subcommittee met at 10 a.m. in room 2228, Dirksen Senate Office Building, the Hon. Philip A. Hart (Chairman of the subcommittee) presiding.

Present: Senators Hart and Hruska.

Staff present: Howard E. O'Leary, Jr., chief counsel; Bernard Nash, assistant counsel; Janice Williams, chief clerk; Peter N. Chumbris, minority chief counsel; Charles E. Kern, II, minority counsel; and Michael Granfield, minority economist.

Senator Hart. The subcommittee will be in order.

Permit me, first, a brief opening statement.

OPENING STATEMENT BY SENATOR HART

This is the beginning of an examination of the third of seven industrial sectors included in the Industrial Reorganization Act.

While there are many who follow the hearings, each change of industry brings us an audience of a somewhat different composition.

I think it would be best to order a copy of the bill. The bill, basically, will do two things; outlaw monopoly power with a few limited exceptions and establish special permission to intercede, either in Congress or a special district of restructuring a major industrial sector.

While each of the industries are similar in many regards, it's the differences more than their similarities, which seem striking.

In a sense, the computer industry may be the most interesting. First, it's a new industry, only 20 or 30 years old.

Although dominated by one company, whose sales figures some say spell monopolist, the computer industry is one of the most dynamic and exciting industries around.

Its capabilities seem to be antiquated as soon as they are voiced. One estimate that I'm sure will not be out of date quite so fast in our lifetime, is that this industry will be number one in sales.

There have been claims that as rapidly as this industry is growing that it is not allowed to mature in a fully competitive atmosphere.

Large companies have entered this industry and have dropped out because they found it, for one reason or another, not desirable to remain in.

We will hear about the competitive structure and practices today and the 3 days following.

Another significant aspect of this industry is its international application, both as it affects payments balances and national policy for the country.

There will be industries from overseas who will discuss these aspects. Let me spend 1 minute on a similarity of this industry to so many others we will examine.

Because of a pending lawsuit, and the action of the congressional committee in light of that pending lawsuit, as Mr. Nicholas Katzenbach, the vice president and general counsel for IBM, will explain in a moment the company did request that these hearings not be held at this time.

The argument was that the Government case against the company is pending and trial is expected in New York in October.

I considered the request—so did the other members of the subcommittee—and concluded that we should go ahead. As I see it, almost anytime we take up an industry for examination there is a case, or several, pending against the members of that industry.

My uneasiness is whether we should defer until litigation is concluded. Congress may not be able to meet its responsibility in reviewing the extent for which the antitrust is containing competition is the policy by which this committee is run.

I have at no time entertained any doubt about the sincerity and conviction of IBM and Mr. Katzenbach in urging delay.

On a personal basis it would be much easier to agree than to disagree, but I have concluded that we should go forward. Our first witness then will be an old and respected friend, Mr. Nicholas Katzenbach, vice president and general counsel of IBM.

TESTIMONY OF NICHOLAS deB. KATZENBACH, VICE PRESIDENT AND GENERAL COUNSEL, IBM CORP., ARMONK, N.Y.; ACCOMPANIED BY THOMAS D. BARR, COUNSEL

Mr. Katzenbach. Thank you, Mr. Chairman. I do have a prepared statement. With the committee's permission, I would like to read it, and I would like to introduce, although I think he needs no introduction to you, Thomas D. Barr, a member of the New York bar and known to you as counsel to the Violence Commission, who is accompanying me to be sure I don't say anything——

Senator Hart. And also Senator Hruska served on the Violence Commission.

Mr. Katzenbach. Yes, I appreciate this opportunity to appear before the subcommittee at the outset of the hearings on the electronic data processing industry.

As you know, I think it is unfortunate, somewhat unfair, and clearly unnecessary, for the committee to hold these hearings at this time and under these circumstances. Unfortunate because the committee deprives itself of expert testimony which would otherwise be available; unfair because whatever the committee's intentions there may be misinformation about, criticism of, and attacks upon IBM which it cannot rebut in present circumstances and which make this record useless as a basis for legislation; unnecessary because all rel-

evant information about the industry will be available to the committee soon in a far more comprehensive, objective, and useful form.

These conclusions stem from the fact that the trial of the case of *United States* v. *IBM* is scheduled to commence before Chief Judge David Edelstein of the Southern District of New York on October 7. The issues in that case, probably the most important and certainly the most complex in the history of the Sherman Act, are broad and will, necessarily, involve extensive testimony on the history of the industry, its competitive structure, the practices of IBM and others, over a period of years, both here and abroad. The facts relevant to the decision of the case—and to the work of the committee—will be brought forth, as they should be, in an objective forum; tested for accuracy by the examination and cross-examination of witnesses under oath by counsel who are not only expert in the law but who have spent literally years in preparation of the case.

This case has been pending for over 5 years. Hundreds of thousands of hours have been spent on both sides in its preparation; millions of documents containing statistics, plans, analyses of decisions, and so forth, have been studied; and many hundreds of other companies with relevant information or expertise have been formally deposed.

The Department of Justice has stated to the court its intention to use some 160 persons as witnesses at trial, and IBM has similarly listed some 400 persons.

These persons include experts of all types: economists, accountants, investment analysts, scientists, and engineers. They also include many competitors, customers, and more than 100 representatives of Federal departments and agencies whose testimony by deposition will be offered by IBM. It has involved and will involve immense cost and effort to the Government and to IBM; but it does and will provide all the factual information necessary for the work of this committee. This committee may question whether or not this long and expensive process is the best, speediest, and cheapest way to develop such information. But there can be no serious question that this process will provide incomparably more accurate, less biased, more comprehensive, and better informed facts than this hearing.

Now, if nothing more were involved I would, therefore, wonder why—with all this information about the industry soon to be available—this committee is holding these hearings. It cannot be to develop relevant information.

Only the committee can answer that question. But lest anyone draw mistaken inferences from it, let me make it unequivocally clear that I intend no implication of an improper motive on the part of the committee, any desire to be unfair, any intention to attempt to influence the result of an important antitrust case on the eve of trial.

I know the members of this committee too well to imply any such motive, and there is no Member of the U.S. Senate whom I regard as more fair, more ethical, more scrupulous in his conduct, than the chairman of this subcommittee, and none for whom I have higher personal or professional regard. Nor do I believe for one moment that Chief Judge Edelstein, or any respected member of the Federal judiciary, could be so influenced.

I can't speak with the same conviction about some of the witnesses the committee has seen fit to invite, though again I do not impugn

the motives of the committee. And whatever is said in these hearings I have no doubt that IBM will get a fair trial in court.

But to say that is not to say that these hearings will not prejudice and damage IBM in other ways. In all honesty I believe they will. For they are almost certain to generate testimony and opinion adverse to IBM in circumstances in which IBM cannot properly respond, offer contradictory testimony, or otherwise defend itself.

And while none of this will affect the judicial process, and hopefully not the testimony of witnesses, it may suggest to the general public, to unsophisticated investors, and even to some of our own employees, that IBM is guilty of something improper.

They will wonder why these hearings are held, why such distinguished Senators do not take exception to at least some of the testimony you will hear, and why—most of all why—IBM does not set the record straight.

The members of this committee, all distinguished lawyers, understand why it would be improper for me, as counsel, to testify publicly about any of the issues in the pending cases. Members of this committee will understand why I would not want—putting ethics aside—to attempt to try IBM's case in this forum. And those who are close to the litigation will know that IBM and the Government are bound by court order to limit scrupulously their comments to the press about matters involved in the antitrust litigation.

I suggest, Mr. Chairman, that much of the information developed at these hearings will be adverse to IBM; that IBM cannot defend itself at this time in this arena; and that to permit such attack—indeed, to provide a public forum for it on the eve of a trial important to this country and important, certainly, to IBM and its stockholders—is inherently unfair.

Not, to repeat, because it will influence the results of the trial, but simply because the trial in and of itself highlights interest in these hearings.

There are many—investors, employees, customers, competitors—who want to guess the results of this litigation simply because they fear it will affect them. And there will be those who do seek to influence public opinion in ways adverse to IBM and who will promote views prejudicial to IBM in every way they can.

As the committee knows, Messrs. McGurk and Biddle of the so-called Computer Industry Association—CIA—have as the principal objective of their employment to make public attacks upon IBM in the interest of their members, a number of whom are suing IBM in the courts. The CIA is not representative of the computer industry. There are such organizations, with significant membership, but representatives of those organizations do not appear on the committee's witness list.

The committee has also invited two economists to testify. Professor Brock recently completed, under the tutelage in part of one of the Government's principal experts, a Ph. D. thesis on the computer industry, which is an important source of the Government's theory of the case against IBM. Similarly, Mr. Miller is an economist who has worked in the Department of Justice, and who has been engaged for some time in assisting in the preparation of the Government's case.

Therefore, if these gentlemen in fact testify, the committee will

be exposed to the Department of Justice's view with no opportunity for rebuttal by IBM.

I say if these gentlemen testify, because it seems to me that the Department may make efforts to persuade them not to because their testimony is so closely related to the Department's pending case.

Two of the witnesses are employed by Control Data Corp., an important IBM competitor, which sued IBM on antitrust grounds in a case now settled. I do not, of course, know the nature of their testimony.

Another heads a company which is also in competition with IBM. He has been a frequently public critic. The two gentlemen from overseas have governmental responsibilities which will inhibit any testimony favorable to IBM.

As members of the committee know, a number of European governments, working in conjunction with the European Economic Community, are subsidizing and otherwise supporting IBM's European competitors.

I assume that there may be other witnesses whose names are included on the list in an effort to balance the testimony in some way or other. I do not know this for a fact, since I do not know, of course, what their testimony will be. And indeed, some of the witnesses are unknown to me or to my colleagues in IBM, and accordingly I know neither their qualifications nor their views.

I say all this merely to demonstrate that it would be unlikely that this committee could get any kind of in-depth knowledge from this number of witnesses in a few hours of testimony, irrespective of their objectivity or their expertise. The facts about this young and dynamic industry are far more complex, as the scope of the Government trial indicates, than can be comprehended in a few short hours. And to repeat, if the committee seriously wants to study the industry, it will have the wherewithal to do so from the record of the Government case. It cannot hope to achieve that understanding in these hearings. It can promote misunderstandings prejudicial to IBM.

I accept the fact that there can be and are circumstances where the fact of pending litigation should not inhibit the need of congressional committees to seek information relevant to pending legislation. But these hearings do not, Mr. Chairman, fit those circumstances. The information developed, irrespective of predictable bias, will be woefully inadequate for any responsible judgments.

And accurate and complete information is and will be available to the committee from other sources.

Mr. Chairman, since I've prepared this statement and submitted it to the committee one event has occurred to which I wish to call your attention, because it illustrates some of the points that I have made.

Yesterday afternoon, the so-called Computer Industry Association, Messrs. McGurk and Biddle, who are witnesses before this committee, being there present, held a press conference about these hearings.

They distributed your opening statement. I assume that they got it from the committee. I assume it was publicly available. They summarized the testimony of witnesses, and they engaged in their customary practice of distributing a great deal of misinformation about IBM.

Now, that is their right. But what distresses me about this, and I think might distress the committee, is the fact that they did so in an

aura in which this committee and this committee's hearings lent some prestige to that press conference.

They purported to be doing this in aid of the committee's investigation of IBM, and even the fact of distributing to the press your statement gave them at least the general aura of being spokesmen for this committee.

Now, I know and I'm sure anybody familiar with you, Mr. Chairman, knows that they do not, in fact, play that role.

But it does illustrate the problem that I have, and I would predict, with virtual certainty, that Messrs. McGurk and Biddle will, in the course of their employment, because that is what they're employed to do, do everything that they can to push in the press, and in the trade press, any statements made in this committee which are or could be interpreted as being unfavorable to IBM: and it seems to me, Mr. Chairman, that that illustrates as well as any point can the problem that I have with these hearings.

Now, if the committee will indulge me, I would like to comment briefly on the broader subject of the work of the committee. I do so because I am personally sympathetic with the need to review the purposes and the enforcement mechanisms of governmental policy toward competition.

Neither the Congress nor the Executive has a clear, consistent, well-thought-out philosophy with respect to laws governing competition—what we loosely call "antitrust." The Sherman Act, perhaps wisely, is cast in very broad terms and has evolved over the years in efforts to adjust to changing circumstances. In the course of this evolution, problems have emerged on which this committee could usefully focus attention.

I think it important that the Government attempt to articulate the philosophy which underlies our governmental policies toward business competition and the factors which should be taken into consideration in its enforcement. At present there are conflicting and inconsistent strains running through our antitrust laws as they have been interpreted by Government officials and by courts. Indeed, Mr. Chairman, the record of your own hearings suggests the lack of a coherent philosophy among those regarded as experts in the field.

At the bottom there are two conflicting themes. One is that the purpose of the law is to promote competition by protecting competitors from the rigors of tough competition. While this is somewhat of a mercantile view—everyone has a right to stay in business—it gets a more appealing populist aura by often being presented as protecting small competitors from large ones, whether or not this protection results in benefits to the consumer. Undeniably this philosophy can have an emotional appeal, but it may be quite inconsistent in concept and result from a philosophy which holds that the objective of competition is to promote the welfare of consumers by encouraging an economic system in which there are rewards for those who are innovative, who can achieve efficiencies, who can provide better products at lower prices.

Some resolution of this basic conflict has become more important and more difficult as many new factors have entered the equation as a result of new technology, industrial maturity, and a shrinking world. Surely our philosophy of competition must take into account our more general economic and political objectives, our ability to compete in

world markets, the fact that other governments may not share our economic views or may have conflicting objectives in terms of trade, commerce, and investment. The efforts by this committee to consider such problems are to be applauded. But, as the committee knows, much more work and analysis needs to be done.

Not only are these problems important to clarify and resolve but the business community has an interest in their discussion, analysis, and resolution. I think, too, that this committee has an interest in enlisting the efforts of the business community in that work. Unfortunately, much of the business community regards itself in an adversary position with the committee—and understandably.

The proposed legislation is cast in terms which promote confrontation rather than objective inquiry. Not only does this adversely affect business cooperation in matters important to that community, but it promotes committee investigations and hearings on precisely the issues which are currently the subject of judicial and administrative hearings, again in an adversary context which is bound to be viewed as unfair and prejudicial by defendants.

Let me turn briefly from the philosophy of laws regulating competition to enforcement mechanisms. Clearly, enforcement suffers not only from lack of a coherent philosophy and conflicting interpretations, but also from the lack of consistent and purposeful administration. And each aggravates the other.

From the national viewpoint, enforcement lies largely in the hands of the assistant attorney general in charge of the Antitrust Division of the Department of Justice and the members, especially the chairman, of the Federal Trade Commission. Both operate with very little guidance from more senior administration officials or the Congress. There is no guarantee that these policy officials agree on objectives—or even jurisdiction—and the rapid turnover of policymaking personnel in both the Department and the Commission in relation to the time consumed in investigation and litigation virtually insures unevenness and inconsistency in enforcement.

And, in my experience at least, there is no satisfactory mechanism for insuring that enforcement takes account of other economic objectives of a particular administration or of the Congress.

Now, all that would be chaotic enough, but it is in fact much worse. The growth of private treble damage suits in the past two decades has meant that a number of private attorneys, representing private clients and not necessarily the public interest, have been promoting interpretations of the antitrust laws consistent with both their client's interests and their own large contingent fees. Each such decision creates legal precedent and this serves to develop economic policy removed from congressional oversight and Executive supervision which placing it in the hands of some 450 district court judges, who unavoidably, have different degrees of experience in economic theory and business practices, and who must formulate their decisions in a framework of facts and policies articulated by private counsel.

I do not have problems with private treble damage cases where the issues involved are unlawful practices: price fixing, agreements not to compete, discriminatory pricing, and so forth. Here it may be useful to engage the efforts of the private bar. But where the issues involve structure—where the lawfulness of a particular practice totally

depends on definitions of monopoly power, market and fundamental economic analysis, it is unwise to leave development of basic national economic policy to a process as unstructured and unguided as private litigation. And I regard it as particularly dangerous to the serious public interest where the lawyers involved may have a huge financial stake in the decision itself.

There are problems, too, with the treble damage suits which may follow a successful antitrust victory by the Department of Justice. Such suits impose huge, and perhaps senseless, burdens on an already overburdened judiciary. I say "senseless" for three reasons: The damages involved are always speculative, involving guesses which in other contexts would be regarded as inappropriate for resolution by either judge or jury. The trebling of such damages is from a plaintiff's viewpoint a pure windfall in a context where there is little public interest in proliferating litigation after the basic economic policy has clearly been established by the relief granted in the underlying governmental proceedings. In this context it is again the lawyers who benefit the most at the expense of an overworked Federal judiciary.

My opposition to treble damage cases following a successful Government antitrust case does not stem from any belief that defendants who are found guilty of criminal practices should not be severely punished. They should be. Existing fines are, I believe, far smaller than desirable, and genuinely severe fines, accompanied by equitable relief, should serve to deter unlawful practices, which is, after all, the underlying purpose of the statutes.

Finally, the committee is well advised to consider, as it is considering, whether or not judicial enforcement in the first instance is the best way of administering laws affecting competition. Federal courts are presently overburdened with work, these cases are large and complex, and there is little provision in present law for judges to secure adequate professional assistance and help in complex economic litigation.

In addition—and this fact goes to more than the work of the committee—Federal judges are grievously underpaid for the importance of their work and the experience and skill which we must attract to the bench. In addition, in many parts of the country court facilities are woefully inadequate; the Southern District of New York is one where that situation is particularly bad.

These are difficult problems, Mr. Chairman, particularly in the political and economic climate prevailing today, and I don't have satisfactory answers to many.

I do believe that the work of the committee will be most productive when it is directed to clarification of the basic objectives of our philosophy of competition and to the mechanisms of its implementation, and least productive when it appears to be examining precisely the issues which are subject to current litigation and which, inevitably, result in partisan approaches to problems which are important to all of us to resolve in nonpartisan ways.

Thank you, Mr. Chairman.

Senator HART. Thank you very much, Mr. Katzenbach. You voice even more explicitly in your statement the concern and the reasons that move you so strongly to urge that we delay.

I would like to have printed in the record an exchange of correspondence that occurred between you and I on that point.

Mr. KATZENBACH. Certainly, Mr. Chairman.

[The documents referred to appear as exhibit 1 at the end of Mr. Katzenbach's oral testimony.]

Senator HART. This, I know, is not the center of your concern, but in partial response, if in your judgment balance could be added to this record from witnesses known to you who are not on the schedule, we would welcome your giving their names.

Mr. KATZENBACH. I appreciate that, Mr. Chairman, but as you know, we have listed some 400 people who will testify in the Government case and I would not wish any of those witnesses to testify here before they testify there. Of course, that testimony will be available to this committee.

Senator HART. I wonder if there has ever been a congressional hearing as thorough as a good lawsuit.

Mr. KATZENBACH. I don't know the answer to that. I would suggest—Mr. Chairman, as you and I know very well, Senator Hruska as well—really extensive hearings by the Senate Judiciary Committee with respect to the 1964 Civil Rights Act.

Senator HART. And they were not as detailed as the Civil Rights Commission finding.

Mr. KATZENBACH. Mr. Chairman, I think on a subject like this it is extremely important that you do have adequate information on a very difficult economic subject.

If I may say so, I do not believe that it would be possible for your present staff, in the time this committee has operated and if they devoted the totality of their attention to the computer industry, to have on that single industry a very adequate understanding; and I don't believe that they would claim to have very much at all.

I don't think that's a good basis for legislation. I think if you are going to undertake this kind of a task the Senate should give to this committee the resources that it genuinely needs to do the study and work to resolve basic economic policy.

Senator HART. I really suffer the same discomfort as I suffered in the very first set of hearings I attended in this committee.

It was back in 1959 and literally, the first hearings were on the steel industry. Along with others, I asked questions of steelmakers. I didn't feel very comfortable.

The next set of hearings had to do with some bills that treated professional team sports. I listened to my colleagues ask questions. It just happened that I had some experience in that field and thought, "Good God, how dumb" those questions were.

This problem affects the whole function of Congress and I wish we could be experts and close down and review steel and review sports, but we can't.

Mr. KATZENBACH. Senator, is that really important?

Senator HART. No; but you suggested we ought to wait until we know fully.

Mr. KATZENBACH. No, Senator. I said if you think it is important that you know every industry in detail, you should wait and get that information. I'm raising a different question now.

I'm saying, Shouldn't the function of this committee be not to determine what should be done about the computer industry or any other industry, but shouldn't your attention be focused on how those problems

are being dealt with in the Government today, shouldn't you focus your attention on the problem of how are those administered and enforced?

Should there be a Federal Trade Commmission and an Antitrust Division in the Department of Justice? Should they be done in the courts? Should there be a commission to do this? What is the expertise of the staff of the Federal Trade Commission? How do they handle cases? How do they make decisions?

Senator HART. The honest, forthright answer, although unwise politically, would be if we had thought of that first, I bet we could have spent 2 years on that.

Mr. KATZENBACH. Productively.

Senator HART. Yes; we think we are doing a constructive job. Now let me get to a point that you referred to in your testimony.

You, for a few years, had an intimate view of antitrust litigation, massive and complex. How can we speed up that process and still assure due process?

Mr. KATZENBACH. Well, sir, I think, myself, and I expressed this view when I was in the Department of Justice, that much of what is done there and the time that it takes is because of the Department's approach to cases itself.

They, to a very great extent; overprepare their cases. They don't put adequate resources into a particular case. Much of what they do is simply in response to private complaints. Little of it has to do with the basic structure of industry.

I can remember one instance, and I will leave out the name of the defendant, where a criminal case was brought by the Antitrust Division, and then they came up to me with some papers and said they wanted to do a great deal more discovery.

I said, "You should be ready for trial. You've brought a criminal case. There's no excuse for the Government not being ready for trial in 90 days."

They said, "Oh, it'll take us 2 more years to prepare this case." And they had brought a criminal indictment against a large company.

I said they could not do that. They had to prepare their case. They ended up dismissing that case, after they got adequate information.

But time and time again, I think the problem was—and it relates to the politics of it—that the head of the Antitrust Division likes to bring a big case and get credit for it and a lot of publicity.

It means you're very active. You're very popular with those who want antitrust law enforced. All you have to do is bring the case.

You're almost never around at trial. You're there at the takeoff, but you're never there at the landing and somebody else is there at that time.

When we went to the Department of Justice, when I went into the Department of Justice, at first we had a whole bunch of cases which Bob Kennedy had to end up dismissing; cases in which there simply was inadequate evidence, cases that had been brought, in my judgment, by the prior administration to create a reputation of vigorous law enforcement. And it's very painful to dismiss those cases because the people who've been in there in the past say, "I don't know why they're dismissing them. It was a good case when I was there. I don't know why it isn't a good case now."

I think that has to be avoided. I think there is politics not in the partisan sense, but I think the head of the Antitrust Division, the head of the Federal Trade Commission, makes his reputation in a short period of time and then goes out and earns a lot of money in private practice, but he makes it from bringing cases; he doesn't make it from pushing those cases, from prosecuting those cases, and from finishing those cases.

A case in which I'm involved was under investigation by the Department of Justice for almost 2 years before it was brought, and that was 5½ years ago.

Senator HART. I ask this question not to suggest I doubt your answer, but do you think there continues to be a need as a matter of public policy for a law that penalizes market dominance when exercised abusively or aggressively?

Mr. KATZENBACH. I think, Senator, that the purpose of the antitrust laws, or present laws, or any future legislation, ought to be twofold.

I think there are some practices, as there are today, which ought to be simply outlawed and made criminal, and as to those, I have no problem at all.

With respect to what you refer to as market dominance, I think there the question is not one of penalizing success if success has been gained in legitimate ways and should not be so viewed.

There, I think, the issue is what structure in that industry, the present one or what other one, will best serve the economic objectives of the country; and I have no problem where that restrains progress, where that keeps prices higher than prices ought to be, where the consumer does not benefit from that, where it, in effect, is noncompetitive.

I have no problem with saying that industry should be restructured so it would be competitive. I don't think that should be regarded as penalizing someone.

I think that should be regarded as restructuring the industry because the public interest so requires.

Senator HART. Well, you have commented on the varying levels of experience and attitude of the district court judges.

Do you feel that the decision as to whether—not calling it punishment or penalizing—restructuring can be handled by these 450 judges?

Mr. KATZENBACH. Under present circumstances, I have serious doubts about it, in part, because I think the law itself is not terribly clear as applied in complex situations and because, of course, the experience of those judges varies so greatly.

There are judges who clearly would be competent to decide those cases. There are judges whom I think are less competent.

I would personally think that in theory it would be better to have a specialized court or administration of the type that you suggest in your bill.

As I've said to you before, less formally, my problem with that is can you attract people of the requisite skill and wisdom and training and background to stay in those positions long enough to accomplish those purposes?

Senator HART. I'm glad we share the feeling that a specialized tribunal could be more effective and consistent. The second question is, could you keep them. Almost as a footnote, you made a comment in your testimony about the judicial pay scale. You have to do something about that.

Mr. KATZENBACH. You really should. We're losing the best judges. Some are being lost, and many cannot be attracted at the current salary scale for Federal judges and it is inadequate; they are embarrassed by lack of funds; they look at what their colleagues are making in the private bar, and it is a real serious problem.

Senator HART. You don't agree with everything I do, but I voted as a big spender on the judicial pay bill.

Mr. KATZENBACH. Senator, I agree with almost everything you do. There's only one big exception.

Senator HART. We are now confronted with a meeting of the full committee in executive session. We did not learn about it until long after scheduling these hearings.

We just got notice of it yesterday, we have to interrupt. My impression is it will not be for very long. Let me see if I can get one more question in.

You talked about the desirability of strong fines for clearly improper conduct and suggested the need to increase the amount that could be applied.

Senator Hruska and I have joined in seeking to achieve that. Your testimony, I'm sure, will help to persuade our colleagues.

You don't say anything about a jail sentence as a deterrent in these things. I have become convinced that a brief jail sentence for someone like you and me is a whale of a lot more deterring than an even longer jail sentence for some fellow that was born in one of those blind alleys and finds jail more comfortable than where he had to live.

How do you feel about the deterrent effect of an occasional vice president spending 30 days in jail?

Mr. KATZENBACH. I think it would be useful. In these days a lot of respectable people are going to jail.

Senator HART. And not going to jail.

Mr. KATZENBACH. And not going to jail. I would be for it. Senator. I don't mean to be facetious. I think if a person violates a clearcut law—he fixes prices with a competitor—he must know that's wrong, and I think they should be personally punished.

The reason I wanted a big fine and do want a big fine for that is I think the only way you're going to get companies, some companies at least, to really police their own practices is to put a genuine penalty on them for that kind of clear conduct. The only kind of conduct that probably should be prescribed by the criminal laws is clear violations, price fixing, that sort of thing.

Senator HART. Thanks very much. I'm sorry, we will have to recess.

[Whereupon, a brief recess was taken.]

Senator HART. The committee will be in order. Senator Hruska?

Senator HRUSKA. Mr. Katzenbach, it is with great interest that I listened to your testimony and, frankly, I think it has a great deal of merit to it philosophically as well as in a practical way. In a practical sense there is a pending case.

And the impact of these hearings upon that case, of course, cannot be evaluated now, but only in the future. In all frankness, I might

observe at this point that I am not in sympathy with the general objectives or the merits of the pending bill, which was placed this morning into the record once again.

Sometimes I am accused of prejudging the case, not having heard all the evidence. To observations of that kind I say any degree of prejudgment or lack of official temperament in that regard is of small consequence compared to that conflict of interest that arises within the breaths and in the minds of the author of the bill who chairs this committee. And certainly, he has a bias in favor of the bill.

I am entitled to my own judgment on it, and in a little while some of the questions which I ask will bear out the principal reasons why I am against this bill.

May I ask you, Mr. Katzenbach: Is this case in New York being tried by the court or by a jury?

Mr. KATZENBACH. Just to the court.

Senator HRUSKA. So, presumably, any of the press notices, either in the trade journals or otherwise, would have lesser impact than if it were a jury case where the panel would get to that material—improperly, perhaps, but get to it.

Is that a fair observation?

Mr. KATZENBACH. Yes; as I said in my statement I am sure it will not influence the judge.

Senator HRUSKA. How long will this trial take from now on, starting in October?

Mr. KATZENBACH. It is very difficult to make that estimate, Senator. I don't know how many days the court will sit. I don't know whether the Government intends to call all its witnesses.

If all of the witnesses are called by both sides, and if the court sits 4 or 5 days a week, it will go over a year.

Senator HRUSKA. How long did the case in Oklahoma City take?

Mr. KATZENBACH. About 6 weeks.

Senator HRUSKA. When was this trial started? When was the petition signed and filed?

Mr. KATZENBACH. In the Government case?

Senator HRUSKA. In the New York case.

Mr. KATZENBACH. The petition was signed on January 17, 1969, the last full day of the Johnson administration. It was the Friday before Mr. Nixon was inaugurated on the Monday.

Senator HRUSKA. Who signed it?

Mr. KATZENBACH. It was signed by the then Attorney General, Ramsey Clark. That came, I believe, as something of a surprise not only to IBM but to President Johnson.

Senator HRUSKA. In your testimony you observe that one purpose of the law is to promote competition. That is, you cite two conflicting things. One is that the purpose of the law is to promote competition not protecting competitors. Is that a valid proposition?

Is that what the antitrust law of this nature is: To protect competitors?

Mr. KATZENBACH. I do not believe that that is what it is, or that is what it should be. I believe that there are decisions where it is very difficult to explain the result in any other terms, or I do not think that any purpose other than that of protecting competitors is served.

I think the purpose of the antitrust laws should be to insure an

economic system, and I think this does in almost all circumstances require competition, and vigorous competition, but a system in which the consumer gets better products at lower prices than he would otherwise get. That seems to me the whole purpose.

I think what that requires in particular industries may be different.

Senator HRUSKA. The bill that we are considering says that if in the judgment of the Industrial Reorganization Court, and after a prosecution by the Industrial Reorganization Commission, it is found that the company is too big, the Court can split it up into pieces of lesser size than the present size is.

What impact will that have on the consumer insofar as prices are concerned? Is there any idea if that result does happen? Instead of having one big company and several smaller, give them each one-tenth, and say, "Go at it now. Now you are on equal terms."

Mr. KATZENBACH. I think the results would probably vary from industry to industry. What is important is that a size that will achieve genuine economies of scale, which will provide for sufficient research and development in order to produce and to innovate new products, should not be prohibited.

Now, in some industries that may be larger than it would be in others. I don't see how you can have a rule of thumb that says when you get to be this size in any absolute sense, or even in proportion to other companies and other industries, that you therefore should be broken up.

We certainly don't want to go back to a cottage industry and hold that out as an efficient economic system.

Senator HRUSKA. What would such a procedure have by way of impact upon competition worldwide? It is thought by some economists that the tendency in Europe and perhaps in Japan is to try to combine some of the companies that they now have in larger units to compete against U.S. firms. In fact, they resort in some places to cartels to achieve that purpose.

Obviously, this Congress has no jurisdiction over them, and they would go on their merry way if they found a competitive advantage to that type of organization.

Now, if there is competitive advantage to that kind of organization, and if in the United States the large companies would be broken up, would it be a reasonable and logical outcome that America would be at a disadvantage in the worldwide market?

Mr. KATZENBACH. I think it might well be in many instances. I think in the past we have competed very successfully in foreign markets, far more successfully than we do today, in part because of the large market provided by the United States. This permitted organizations to increase in size and to achieve various economies of scale in ways which were extremely difficult—at least prior to the Common Market—for European companies to accomplish. I think, appreciating that fact and in response to American competition, Japan and Europe are doing precisely what you suggest.

Indeed, there is subsidy in both Europe and Japan in some industries, certainly in the industry in which I am presently engaged, which is done for the purpose of trying to achieve those economies in order that those companies can enter the United States market.

Senator HRUSKA. One of this country's aches and pains is its balance of payments and, of course, exports. We will be handicapping our economic structure here to satisfy the whim and the current mode, or the populous demand for smaller sized companies, resulting in an undue regard for size, without reference to economic and industrial efficiency.

There is going to be a price to pay, isn't there?

Mr. KATZENBACH. I would think there would be, Senator. And I would think that in many of the larger industries one of the circumstances which should be looked at by those enforcing the antitrust laws, or by this committee if it engages in industry studies, is what is the effect of this with respect to balance of payments? What is the effect of this with respect to national defense considerations? What is the effect of this with respect to foreign competition and employment in the United States? I think those are valid economic considerations to consider in trying to structure what your economic philosophy with respect to competition should be.

Senator HRUSKA. Would another field, for consideration of this committee and of the Congress, be that our antitrust laws have extraterritorial effect, at least in theory? There is an effort made to enforce extraterritorially our antitrust laws.

Isn't it a fact that there is very often in foreign countries a requirement that any industry coming to a certain country will have to get into a cartel, usually with the government itself, and to respect and to totally comply with the territorial restrictions in their activity in connection with that joint effort between the government and the American corporation. So we have a built-in prohibition of an American corporation getting into a situation like that because of our antitrust laws, and their extraterritorial application, or, in the alternative, have them go abroad and engage in it and become guilty of violating the law?

Mr. KATZENBACH. Yes, Senator. I think circumstances of that kind can occur. I think in addition to that American businesses in this country face feelings of economic nationalism abroad, so that foreign governments often prefer, sometimes by law are required to prefer, products made by their own local manufacturers, and this amounts in a way to a subsidy of those firms and makes competition more difficult for American firms.

I think there are circumstances where you can be required by foreign law, as you point out, to engage in activities that would otherwise be illegal.

I think in the enforcement of our antitrust laws, normally if those are the facts that there is an attempt to take that into consideration and not to put a company in a, "damned if you do, damned if you don't" situation.

But there is no guarantee that that could be true.

Senator. HRUSKA. You have commented on the inadequacy of professional assistance to our trial courts. We do make an effort in one field, certainly, to provide that assistance. That is in the U.S. Court of Customs and Patent Appeal. They do have a technical staff, dealing as they do with highly intricate and technical subjects, but certainly no more highly technical or intricate than the subject matter,

for example, of the lawsuit you are going to get started in on October 7; is that correct.

Mr. KATZENBACH. Yes; that is certainly true. Senator.

Senator HRUSKA. Any remarks you might have made about the district court are not in derrogation of the capacity of the judges, but they certainly would have some bearing on the lack of equipment that they have with which to discharge their duties. Am I correct?

Mr. KATZENBACH. That is absolutely correct.

Senator HRUSKA. Do the antitrust suits get into patent law?

Mr. KATZENBACH. Many of them do, and that is a complicated area. But even absent patents you can have a complicated economic consideration, complicated technological considerations, and Federal district judges normally have only the assistance of one or two young law graduates as clerks. There are really no facilities and very little in the way of funds available for them to engage independent experts, as I think many of these cases, if not required, would certainly make it very desirable.

It is a huge job for one man, and I think he could use the help of objective experts to assist him. But there is no provision in the law for that, and you have to kind of gerrymander at the moment. That is, if the parties to a lawsuit would be willing to put up on each side the money required for the judge to engage some expert, and the judge wanted to, that device would be available to him.

But I believe that judges ought to have the funds and the wherewithal to engage expert assistance on their own behalf.

Senator HRUSKA. In past years, in the courts of equity, the courts were able to appoint masters.

Mr. KATZENBACH. Yes.

Senator HRUSKA. They delegated to them the task of determining facts, and they made available to them very often technical people, people who were drawn from the field involved in the litigation, and they proceeded in that way.

One principal or historical example is when Charles Evan Hughes was appointed master of the *Great Lakes Water Level* case.

I don't know how long it took, probably 2 or 3 years, to work out a master's report on that for the benefit of the court.

Is there any possibility of going in that direction in cases of this kind?

Mr. KATZENBACH. Yes; there is a capacity to appoint masters in that way, and that is useful. It is not what my remarks were primarily aimed at, because when you appoint a master to assist it goes through the normal judicial process with the evidence, hearings, argument, and so forth, before the master. The master then files a report and the judge either accepts or rejects the findings of the master.

I think in addition to that a judge simply needs help in the understanding of technical issues in a far less formal way than a hearing before a master.

One example that you may be familiar with, Senator, is the *United Shoe Machinery* case which was tried before Judge Charles Wayzansky in Boston. He was able to employ a distinguished economist, Karl Kaysen, who assisted him in the case as a clerk, although Dr. Kaysen was not at that time a lawyer but acted as a clerk and assisted the judge in the preparation of his opinion and his economic analysis.

That is the sort of thing that I had in mind.

Senator HART. Mr. O'Leary.

Mr. O'LEARY. Mr. Katzenbach, we have heard and read about the resources which have been brought to bear in the litigation between the Government and IBM.

I would like to inquire if you would have any objection to supplying for the record the resources which IBM has brought to bear in that case.

By that, I mean the approximate number of documents which IBM has produced, the approximate number of documents which other witnesses in the case have been called upon to produce, the approximate number of attorneys and other personnel working on behalf of IBM, and the estimated cost to IBM of defending itself in that case.

[Material not supplied.]

Mr. KATZENBACH. I think some of that material can certainly be supplied. Frankly, I would have no way, Mr. O'Leary, of estimating the cost to IBM of defending that case.

I really wouldn't know how to do it. I have no estimate of the number of hours of management time that have been spent on various aspects of this. I wouldn't know how to do that. I know it is a real cost.

I would have no way of breaking out the number of hours spent by people on this case and other similar litigations that we are involved in. I don't think I could provide accurate figures in that regard.

Mr. O'LEARY. Could you help us with respect to the cost of outside counsel?

Mr. KATZENBACH. What?

Mr. O'LEARY. The cost of counsel.

Mr. KATZENBACH. I would have to allocate that from one matter to another in various ways. I don't know what that would involve, and it seems to me that it would be far more appropriate to put in at the end of a case than it would be when a case is ongoing.

Mr. O'LEARY. Mr. Katzenbach, do you believe that the Government has the necessary resources to prosecute a case of this dimension?

Mr. KATZENBACH. I do; yes. Mr. Barr points out to me that the judge has asked that question repeatedly, and they have repeatedly affirmed that they have all the resources that they need.

It does seem strange to me, Mr. O'Leary, to think that a private corporation might have more resources than the Government of the United States.

Senator HART. If I could go back to the days when you were responsible for budgeting, while you knew that you were representing a power greater than any private power, weren't there days when you found you needed an extra clerk and couldn't hire one because we hadn't given the money?

Mr. KATZENBACH. I didn't find the problem then very different from the way I find it now, Senator. I could use three hands today, and I could have used them then.

Senator HART. But to suggest that because the Government is enormously powerful that therefore the resources are available to base an antitrust action on doesn't hitch up. It depends on how much Congress gives the Department to do its job.

Mr. KATZENBACH. Of course it depends on how much Congress gives it, Mr. Chairman. But I find it difficult to believe that the Antitrust

Division of the Department of Justice—with 200 or 300 lawyers, has the assistance of the Federal Bureau of Investigation, has the assistance of other departments and agencies—is not equipped to try a case, any case.

Oh, everybody complains in the Government about their own budget. Of course they do. They always want more resources in any department.

Senator HART. Is there any truth—it is almost a folk story now—that there was once upon a time some person in the Justice Department who decided it was time to take on the automobile industry. One of their explanations for not doing it was, "My God, we will be lost for 10 years. We won't be able to do anything else."

Can you confirm that folk story?

Mr. KATZENBACH. Not only can I not confirm it, but there were seven cases brought against members of the automobile industry at the time that I was in the Department of Justice.

Senator HART. A basic case to restructure or dismantle?

Mr. KATZENBACH. That issue came up from time to time, and basically, the reasons no case was brought were twofold. One was a very serious question as to whether a case could properly be brought—a restructuring case—against that industry, and, more importantly, you didn't know what you would do if you won it.

Senator HART. That is another reason we think this industrial court concept would help us. The issue would be largely with "what we can do." Can we do anything better?

Mr. KATZENBACH. Well, as Mr. Kuaper said recently, the restructuring of an industry is an extremely complicated affair and one in which there is great risk and hazard involved if it is not done with the greatest care and the greatest skill.

And even if it is the restructuring may not work out in the way in which honest and intelligent men anticipated that it would.

Mr. O'LEARY. Mr. Katzenbach, what about this situation? Let's assume that a firm starts out in a competitive industry and simply outmarkets every other firm in the industry and it does so to the point where it achieves monopoly power.

Let's assume further that it just outcompeted everybody else; no predatory pricing, no abuse of monopoly power. Now, in your opinion, is it wise public policy to seek to dissipate that monopoly power and make the industry competitive once again? Or should we just tolerate the existence of that monopoly power?

Mr. KATZENBACH. That is an interesting question and one which has never come up at any time in any industry in the history of this country.

I could answer that question only if you could tell me why it was that this hypothetical company that you have described can continue to be successful.

Is it because it is more efficient? Why is there nobody else in that business?

As you describe it they, simply by superior skill and marketing, have achieved the position where nobody else can compete, where, presumably, nobody else can get into that market.

That is a very peculiar situation and one that has never occurred. Mr. Barr points out, if that is the situation, then there must be com-

petition, because nobody else is coming in. and it must be that it is easy for people to come into that industry.

And for that reason this hypothetical company has to charge prices and market in such a way that nobody else is attracted into that industry.

Now, that means, from any decent economic analysis, that there must be competition ready, able, and willing to come in to force that kind of result.

And the competitive system has produced this and continues to produce this. As, again, Mr. Barr pointed out to me, if that means that the consumer is getting the best product at the lowest price, and I suppose that is what it does mean in your hypothetical, then that is not such a bad objective.

What do you want to do—create a situation where you have less good products at higher prices in order to have competitors?

That's the objective?

Senator HRUSKA. Would counsel yield?

What about the monopoly of a newspaper in a large city? Many large cities, in fact all but a handful of cities, in America have only one daily newspaper. Is that a monopoly?

Mr. KATZENBACH. It is not really a very useful concept in those circumstances. There normally is some competition even on the news side. Normally in a city you are getting competition for your advertising dollar from radio and television.

You are getting some competition from newspapers in other cities if it is a nationally advertised product.

That is a problem that came up. It came up in the Department of Justice when I was there. Because of increasing costs in the newspaper business it simply wasn't possible in many places to have two newspapers.

I thought it was desirable from a news point of view, the editorial point of view, to have two newspapers, but the economics in the newspaper business in many cities simply did not permit that.

Now, I don't know what you do in that kind of a situation to create another newspaper. There is nothing, it seems to me, unlawful in that kind of a monopoly, and, indeed, I don't know a good answer to it.

Does the Government want to subsidize another newspaper? I think that would be a horrible result.

Senator HRUSKA. Well, of course, it depends on what the market is as far as news is concerned. I suppose you will have other forms of media.

I don't know of many cities where there are more than one daily newspaper. And that is the situation in most of the cities of America.

Mr. KATZENBACH. I think with the costs in the newspaper business that that is the situation, and it is probably simply not curable.

Senator HRUSKA. Thank you, Mr. O'Leary.

Mr. O'LEARY. I understand, Mr. Katzenbach, that you don't believe that a situation like that has occurred. You find it difficult that it could occur.

But let's assume that it does. Should the law reach that situation or not?

Mr. KATZENBACH. I don't see why it should. On the facts that you give in your hypothetical I see no purpose that would be served to cure a result that was achieved by competition and is maintained by competition.

Mr. O'LEARY. For example, if Alcoa had achieved its 95 percent share of the market without any abuse of monopoly power or intent to use it, in your view it would be wise public policy to leave that state of affairs undisturbed?

Mr. KATZENBACH. I hadn't thought that your hypothetical would have included the *Alcoa* case. It wasn't so stated, Mr. O'Leary.

Mr. O'LEARY. I am obviously adding a couple of things to this.

Mr. KATZENBACH. That is an interesting situation that you put with the aluminum company because what would you do to cure it?

Would you say it is better to have competition even if the result of that is higher prices to the consumer?

You would have to guarantee to me, before I would accept it, a situation that says you are going to get out of this better products at lower prices.

In the aluminum situation my recollection is—you can correct if I am wrong—that, in fact, nothing resulted out of the decision of the case, that you've got competition in the aluminum business largely as a result of the demands for aluminum in World War II, out of the creation of additional facilities at Government expense and that Government, in effect, subsidizes in order to create additional aluminum.

Out of that wartime situation you did have additional competitors in the aluminum industry. That was the cost of it.

Mr. O'LEARY. Aren't we better off from that experience, for that affirmative action on the part of the Government?

Mr. KATZENBACH. I don't know what would have happened in the absence of that.

Mr. O'LEARY. I have no further questions, Mr. Chairman.

Senator HART. Let me put this ultimate idea out. Some company in this country manages to attract the finest minds and over a period of time, using only legitimate means, manages to become the sole producer of everything.

Now, how do you react to that?

Mr. KATZENBACH. Fantastic management.

Senator HART. Wouldn't you agree that that suggests the kind of reasons to persuade some of us that raw economic balance sheet bookkeeping alone should not determine at what point private power becomes a threat.

Mr. KATZENBACH. I am not, Senator, very sympathetic with that view.

Senator HART. Would you be comfortable with that one source of employment, or product, or regional influence?

Mr. KATZENBACH. It is even more difficult for me to conceive of your hypothetical than it was Mr. O'Leary's.

And if, indeed, that came to pass, as you put it, I would suppose the time for change had long since gone by, because that one company producing everything would probably be producing the Government too, and wouldn't——

Senator HART. That's right, where should we blow the whistle, at what level of concentration? That is exactly what I am trying to find out.

Mr. KATZENBACH. For political reasons?

Senator HART. Social, political, that is exactly what I am trying to find out. It is too late when it gets too big.

Mr. KATZENBACH. If that really is the concern of the committee I think we are many, many years from that, and I don't see how that really could come to pass.

Your hypothetical, as you give it, has to assume in this society that somehow or other the competitive system is not working and nobody is enforcing any of the existing laws.

Senator HART. Nobody is violating any laws. That develops as part of my hypothetical.

Mr. KATZENBACH. I don't see how that is going to be possible in your hypothetical. That is going to be done without acquisition.

It really, Senator, is so far out that I have difficulty conceiving it. I do think you run into a difficult problem when you say you wish to regulate the economy in a way that will not produce better products at lower prices for people because you are simply concerned about size.

Now, that really is going back to an old mercantilist theory, saying it seems to me, somehow or other people have got a right to be in business to be successful and to make a profit and the consumer has to pay for that.

I don't accept that.

Senator HART. Any further questions?

Senator HRUSKA. Well, just this observation.

Isn't the Hart industrial reorganization bill a massive attempt to create a governmental organization that will be responsible for business judgments at the expense of two big factors in America: No. 1, industry, as such; and No. 2, the consumers who use the products of that industry?

Mr. KATZENBACH. I do, in fact, Senator, think that that would be the result of the bill as it is presently drafted.

Senator HRUSKA. It has to be. We have here an Antitrust Department, whether it is the Antitrust Division or whether it is the Federal Trade Commission or whether it is the Consumers' Protection Agency, God forbid, or whether it is an industrial organization commission and industrial organization court.

It is political in origin and nature. It cannot help but be that.

Mr. KATZENBACH. I think that is correct, Senator.

Anytime the Government acts, almost by definition, it becomes political.

Senator HRUSKA. I would go along with that part of the paper in your position, when you say there are types of activities that our Government should carefully control, police, and enforce.

But when we get into the area that involves business judgments and activities that are legal and lawful and are not predatory, and so on, then we are in deep trouble, if we are going to get to the point where we are going to form a Government entity to say, "Well, we will step in and we are going to exercise judgment; all you have to do is comply and pay for that compliance."

That is a little difficult to accept unless there is a demonstration, unless there is proof that the benefits of such results will outweigh the cost thereof, whatever the cost might be in money, or disadvantage, or price of goods, and so on.

Isn't it a matter of balancing one or the other?

Mr. KATZENBACH. Yes, it is, Senator. I agree with that.

Senator HRUSKA. Thank you.

Senator HART. Mr. Barr, did you care to add anything in light of the exchange?

Mr. BARR. Maybe after the cases are over, Senator, I would have a lot to say, but not now, thank you.

Senator HART. Thank you very much, gentlemen.

Mr. KATZENBACH. Thank you, Mr. Chairman.

Senator HART. The decision as to whether to recess now or later has been sort of resolved by that vote signal. The signal has just been given which indicates a rollcall is in process on the floor.

I would suggest, therefore, that we recess until 1:30 p.m.

[Whereupon, at 12:18 p.m. the subcommittee recessed, to reconvene at 1:30 p.m. this same day.]

[The following was received for the record.]

MATERIAL RELATING TO THE TESTIMONY OF NICHOLAS deB. KATZENBACH

Exhibit 1.—*Exchange of correspondence between Senator Hart and Mr. Katzenbach re hearings postponement request.*

IBM,
INTERNATIONAL BUSINESS MACHINES CORPORATION,
Armonk, N.Y., June 28, 1974.

Hon. PHILIP A. HART,
Senate Office Building,
Washington, D.C.

DEAR SENATOR: I want to thank you for the courtesy which you showed in talking with Mr. Barr and me with respect to the possible hearings of your subcommittee in the near future with respect to the data processing business. You were generous with both your time and thought, and I sincerely appreciate it—whether or not we have persuaded you of the merits of our position.

I gave you the principal reasons for our very strong belief that these hearings, coming immediately before the biggest antitrust trial probably in the history of antitrust enforcement, are unnecessary to the substantive work of your subcommittee and potentially prejudicial to IBM. For your convenience, I am attaching another copy of the memorandum I prepared on this subject, but I would like to add a few words, based on our discussion, to what I said there.

You pointed out to me that if your committee could not have hearings with respect to so-called concentrated industries because of the fact of pending litigation, then, in many instances, the committee would be precluded from knowledge with respect to that industry. To a degree, this is, of course, true. But I do think the IBM istuation differs from the others which the committee has under consideration. I offer the following reasons for this:

1. THE IMMINENCE OF TRIAL IN THIS CASE

The trial of *United States* v. *IBM* is scheduled to begin on October 7, and Judge Edelstein has made that a firm date. In effect, the very burden of the work of preparation for that case precludes our participation in any hearings on the industry which you might wish to have. In addition, if prejudicial publicity in fact occurs, it will occur virtually on the eve of the trial. I do not suggest such publicity would influence the objectivity of the court, but it could influence the testimony of witnesses and certainly would have an adverse effect on employees and on the press reporting of the trial.

2. THE SCOPE OF THE CASE

Unlike the other industries which you had under consideration, the IBM case involves the whole history, structure, and practices of the industry for a period of years, both here and abroad. Everything about the industry—every fact which the committee could wish to know—is likely to be thoroughly investigated in the course of proceedings which will involve many hundreds of witnesses, many

thousands of documents, and which will last for over a year in my judgment. All of that information will be available to the committee in making its decisions, and if any area is omitted, the committee should appropriately have hearings with respect to that area. Thus, the situation is not one where the committee wishes to make a broader investigation than might be involved in particular litigation, and certainly is not one in which the committee will have to develop information not otherwise available to it. I think this fact alone is adequate distinction from the other matters before your subcommittee.

In this connection, I would make the further observation that the committee can not possibly in three or four days of testimony—even if that testimony were to be unbiased—gain anything approaching the understanding of the industry which will be revealed in the trial of the IBM case. I could emphasize this point by the fact that the Department of Justice has had many people involved in this case for a period of some seven years, a fact which is in stark contrast to the resources of the committee's staff, and the time they have been able to spend on this industry.

3. THE FACT THAT THE GOVERNMENT IS THE PLAINTIFF

In my opinion the fact that the suit against IBM was brought by the Department of Justice, rather than a private party, puts IBM at a peculiar disadvantage. I am sure that the Department of Justice would not testify on this subject, if invited by the committee, on the grounds that it would be improper for them to comment on pending litigation. There are, however, a number of competitors who have a vested financial and business interest in the success of the government in this case. However biased, prejudiced, or inaccurate their testimony before the committee, the very fact that the Department of Justice has brought a case against IBM tends to throw a mantle of objectivity and "public interest" over their statements. The government, therefore, can take the high road of not testifying while others make a public presentation of what they characterize as the Department of Justice's viewpoint.

4. THE PRETRIAL ORDER OF THE DISTRICT COURT

There exists a Pretrial Order from the Southern District Court of New York which prohibits either party from making any public comment on the pending case. This Order was originally sought by IBM because of inaccurate leaks of information with respect to discovery by the Department of Justice. It is, however, cast in extremely broad terms. While I do not believe the court would object to IBM's testimony before a Congressional committee in response to either a subpoena or an invitation, it would be virtually impossible to testify without commenting on issues soon to be litigated in the government case. Even if the court were to permit such general comment, any IBM witness would be acting to a degree at his peril in trying to define the line between what the court would regard as proper and improper.

I cannot honestly take the position that the foregoing reasons, as supplemented by the attachment to this letter, are in any sense conclusive as to the need or propriety of the hearings which the committee is contemplating. I accept the fact that reasonable men could differ with me. I do think you appreciate that I make these arguments with sincerity and with conviction. And I believe you think they have some merit, although they may not be persuasive.

If I am correct in these beliefs, I wonder whether you would find it possible to share this letter, and the attached memorandum, with other members of the subcommittee. While I would like you to do so, I will, of course, abide by your judgment. From long acquaintance and experience, I know that it will be a fair one, even if I disagree with it.

It was good to see you. Once again, my thanks for your time.

Sincerely,

NICHOLAS DEB. KATZENBACH.

June 27, 1974.

Memorandum:
Re: U.S. v. IBM

FACTS

1. The Department of Justice began its investigation of IBM in early 1967. IBM cooperated fully in this investigation. IBM voluntarily produced several thousand documents requested by the government. The suit against IBM was

filed by the government on January 17, 1969, the last day of the Johnson Administration.

2. The Department of Justice did virtually nothing to prepare the case for trial during the first two to three years of the Nixon Administration. During the last two years both sides have been actively involved in discovery and depositions. IBM has produced to the government several million documents, and the government as user has produced from various agencies several million documents to IBM. In addition, the government and IBM have deposed over a thousand witnesses.

3. Trial date has been set by the District Court in New York (Edelstein J.) to begin October 7, 1974. He has stated that that date is absolutely firm, and he will brook no further delays. The government has submitted a witness list of some 175 witnesses, and IBM has submitted a list of some 400 witnesses. Both lists contain many people with expertise in the technology, economics, and experience in the industry. Both lists contain IBM's competitors, and IBM is offering testimony from a large number of users of its equipment. The trial will take approximately a year or more, depending on the number of days which the court sits each week.

4. To give some notion of the work required for preparation in the case, in the last 60 days alone IBM has spent 405 days in deposition, 590 days interviewing witnesses, and over 7 million documents have been produced by both sides. This has involved over 25,000 hours of lawyer time, and many times that in assistance from paralegals and professionals. There is no reason to believe that the pace of this work will slow down between now and the time of trial.

Other Litigation

1. At about the time the government filed suit, one major competitor of IBM (Control Data Corporation) sued IBM, a leasing company sued IBM, and a leading producer of software (programming) sued IBM. After extensive discovery in these cases, they were settled.

2. About a year after the government filed suit another leasing company (Greyhound Computer Leasing) sued IBM. After extensive discovery, this case was tried in Phoenix, Arizona. At the end of Greyhound's case, Judge Walter E. Craig dismissed the suit for failure of proof. He stated that whatever IBM's success in the industry, it was clearly based on IBM's "superior skill, foresight and industry". Greyhound appealed that dismissal, and the matter is presently pending for decision before the Ninth Circuit Court of Appeals.

3. Two and a half years after the government suit was filed, the Telex Corporation filed a suit against IBM. After extensive discovery, this case was tried before Judge Sherman Christensen in Tulsa, Oklahoma. Judge Christensen held for Telex on some of the antitrust issues, and for IBM on its counterclaim that Telex had stolen its trade secrets. He awarded Telex damages in the trebled amount of $259.5 million dollars. He awarded IBM damages of $21.9 million on the trade secret theft. Both sides appealed and the matter is presently pending for decision before the Tenth Circuit Court of Appeals. Judge Christensen held that it was unlawful under Section 2 of the Sherman Act for IBM to make general price reductions to the level of Telex's competitive prices, even though after such reductions the products involved were still profitable to IBM. He found that IBM had a very high share of products which were connected to IBM's central processing units, that as a consequence IBM was dominant in the market defined by products connected to IBM central processing units, and that it was unlawful for IBM to reduce its prices if this in any way was intended to injure a competitor by retaining business for IBM.

4. Following Judge Christensen's decision in the Telex case, a number of competitors similarly situated to Telex have filed suit against IBM, and these suits have been consolidated in California. The work described above in connection with the government case does not include the work in connection with this other litigation, which also involves thousands of hours of lawyer time and massive discovery.

Argument

The Senate Hearing on the electric data processing industry at this time, while the government case is pending for trial within less than four months, can only be prejudicial to IBM, and cannot be expected to develop anything approaching the extensive information with respect to the industry which must be developed in the government case. The issues in the government case are co-extensive with all of the issues which can be raised with respect to the electronic

data processing industry and the position of IBM in it. All aspects of the industry in the United States and abroad will be covered by the more than 500 witnesses whose testimony will be taken. Nothing that the Committee can presently do will come anywhere near the rigorous testing which is bound to take place in the government antitrust suit.

On the other hand, hearings at this stage of the game are bound to be prejudicial to IBM. Leaving aside the proprieties of participation by a defendant in a public hearing immediately prior to trial of the same issues, it is a physical impossibility for IBM lawyers to prepare witnesses for such a hearing. We must concentrate all of our resources towards presenting our case in the Southern District of New York. Nor would it be desirable, from IBM's point of view, (again leaving aside questions of propriety) to attempt to present its case before a Senate Committee prior to hearing the evidence which the government will produce.

It would be equally prejudiced and improper for the government to present its case against IBM before a Senate Committee immediately prior to trial. There is every reason to believe that the government, for the same reasons as IBM, would decline to do so.

On the other hand, there is no lack of people who have a vested interest in public attack upon IBM. Some of these have law suits presently pending against IBM, and based upon past experience, have no hesitation in taking advantage of every public forum to attack IBM. There are organizations, such as the so-called Computer Industry Association (CIA), which represents a small segment of the computer industry and none of the important competitors, but which has as its sole purpose the promotion of anti-IBM literature. And there are a group of professional IBM haters who continuously look for a public forum in which to attack IBM. If the Committee hears witnesses such as this, without the opportunity or time for exploring all of the aspects, then the result will be merely to create a one-sided misimpression of the EDP industry. There is every reason to believe this is precisely what will occur.

Obviously, the Committee must be free, irrespective of pending litigation, to explore those matters which are important to its mission. But here, unlike other industries which also have some litigation pending, the issues in the government case and the issues of interest to the Committee are totally and completely overlapping. There is no reason to believe that it is possible for the Committee to explore these problems in the depth they will be explored in the pending litigation, and all of that information will, of course, be available to the Committee. If there are issues not developed in the government case, the Committee could, at an appropriate future time, explore those issues to supplement the record in the case. And the timing of these particular hearings is as prejudicial as any timing could possibly be from the point of view of the defendant.

NICHOLAS DEB. KATZENBACH.

July 8, 1974.

Hon. NICHOLAS DEB. KATZENBACH,
General Counsel, International Business Machine Corp., Armonk, N.Y.

DEAR NICK: Once in awhile an easy one comes along. Most of them are tough. Once in awhile an extra-difficult one comes along, and what to do about the Subcommittee's hearings on the computer industry is one of the few which are so tough that you wish you were in Tahiti.

There was no mistaking, as we visited with you and Tom, the depth of your conviction that in proceeding with the four days of hearings in July, IBM would be prejudiced by the publicity. Additionally, it would confront you with the dilemma of whether to present in testimony IBM's point of view in advance of the October trial, or leaving much of the time to the critics, and no Subcommittee hearing would approach in thoroughness the record to be anticipated being made in the trial at the District Court in New York.

I am not sure what fact is strongest in persuading me that we should go forward with the hearings. If we were to postpone until a "better day"—meaning one when IBM would not be in, about to go in, or just coming out of, a lawsuit—we would be postponing for a long time. That other industries would assign similar reasons for postponing their hearings, I have no doubt. And at least some would be convinced that any distinction we sought to draw were strained. I cannot claim that there would be no publicity for the very purpose of a Congressional hearing is to stimulate discussion and direct attention to some problem, real or imagined. But I am sure you were right that the trade press, in the

case of the computer industry, would give it thorough coverage and I would incline to the belief that most of the general press would find it unnewsworthy, and those who ran it at all would do it as a one-day report. In any event, in contrast to certain other events and anticipated trials which will go forward nonetheless, it will get very little attention.

Feeling as I do that Congress must attempt to put antitrust on a more effective course, while not claiming that the reorganization bill is the answer, it is my decision that we should proceed with the hearings. I am under no illusion that four days will do other than hit highlights, and it will be many months before we get even to the first stopping place to see what the records suggest with respect to legislation. At best it will be slow and I conclude we ought not, in this case, make it slower.

That this will make disappointing reading for you, I have no doubt, and that really is why the decision and letter are so difficult.

Sincerely,

PHILIP A. HART.

Exhibit 2.—*Letter From Association of Data Processing Service Organizations, Inc., Transmitting Position Paper re IBM Monopolization of Software and Services Industry*

ASSOCIATION OF DATA PROCESSING SERVICE ORGANIZATIONS, INC.,
Montvale, N.J., August 16, 1974.

Hon. PHILIP A. HART,
U.S. Senate, Senate Office Building,
Washington, D.C.

DEAR SENATOR HART: The Association of Data Processing Service Organizations (ADAPSO) has been following closely your hearings on the Industrial Reorganization Act, as it pertains to the computer industry.

It is unfortunate, that the representative Association for the computer services industry did not have the opportunity to verbalize its position before your Committee. We hope at some later date, that we may be able to contribute testimony before your Committee. I enclose a series of position papers produced by the Association that may be of interest to your Committee and its deliberations.

On behalf of the Association, I again reiterate our desire to cooperate with you and your Committee in the near future.

Respectfully,

JEROME DREYER.

ADAPSO/SIA POSITION PAPER ON IBM'S MONOPOLIZATION OF THE SOFTWARE PRODUCTS AND SERVICES INDUSTRY

INTRODUCTION

ADAPSO/SIA is the trade association representing the software segment of the computer industry. Its members are engaged in the marketing of software products and software services to computer users and to hardware manufacturers.

We believe the IBM Corporation is currently, and has been since before the announcement of System/360, monopolizing in the area of software product development for IBM computers. This monopolization, which has resulted in the inefficient use of IBM hardware by the Government and by commercial users, is a major contributor to high cost and poor utilization of computers.

Consequently, this paper requests the Justice Department to eliminate what we believe to be unfair competition and illegal practices under the current law of the United States.

HOW IBM'S CURRENT SOFTWARE PRODUCTS MONOPOLY AND POLICIES HURT ALL USERS OF IBM HARDWARE

An extremely important and often overlooked factor contributing to poor computer usage is the cost and quality of the required software (programming) effort. The performance of hundreds of thousands of programmers is directly a function of the software tools available to them. Operating systems, computer languages, compilers, programming aids, performance measurement systems, sorts, data management packages, and other software are currently being given

ostensibly "free" by IBM to users of IBM computers. ADAPSO/SIA believes that over the last fifteen years IBM has profited by this monopoly of the software industry to the detriment of all users of IBM computers.

It is well known that although IBM does market software capabilities, they normally price only their hardware. As a result, IBM is motivated to produce the minimal software necessary to sell computers, or to produce software that maximizes the utilization of its hardware. Each software expenditure is evaluated in terms of its contribution to selling more hardware. Under such conditions, the user is the loser, since independent software companies which cannot compete against ostensibly free or misprices software are forced out of the market. Thus, less revolutionary computer software is developed and fewer innovations or improvements are made.

IBM's monopoly over the software industry, therefore, is a real contributor to the ineffective use of computers, rather than IBM's control of the hardware industry. Substandard software, as fostered by the current non-competitive climate, increases the cost of computer usage and the number of day-to-day problems encountered by computer users.

It is important to recognize that the efficient utilization of computer hardware is dependent on the software or data services being used. Good software, therefore, must not simply work, but it must work as effectively as possible to minimize overall operating expense. This objective is patently inconsistent with IBM's goal of maximizing the number of installed mainframe computers, which is particularly true of the manufacturer which has captured more than majority of the market.

To the extent that a computer buyer uses the software and services so supplied by IBM, the user may experience poorer equipment utilization and excessive equipment requirements. There is less incentive to IBM—indeed, there is a penalty—to supply optimum software or services. Further, there is no incentive to IBM to cooperate with or contribute to the formulation of standards that would minimize in any way the computer run time necessary for widely used programs.

Finally, it must be recognized that, by virtue of its dominant position within the industry, IBM conditions that market so that both users and competitors are forced to react rather than initiate.

PROBLEMS IN COMPETING WITH IBM

The difficulties in offering viable alternative sources of software to the computer-using community are compounded by IBM's marketing policies and practices. The obstacles to be confronted include:

(a) "Free" Competition

Software manufacturers must compete against "free" IBM products or services whose costs are actually buried in the price of hardware.

(b) Unfair Sales Practices

IBM offers "tied-in" products or services which are selectively priced and/or supported in such a way as to preclude potential competition.

(c) Inadequate IBM Product Information

Many software products or services must be developed with less than adequate background information necessary to interface with existing IBM systems—either hardware or software.

(d) Pre-announcements

IBM competition must cope with software which is pre-announced and not even available from IBM. Further, competitive software products and services must be continually modified to interface with IBM products and services that have been released prematurely or redesigned specifically to eliminate competition rather than to better serve the customer.

(e) User Discrimination

Finally, IBM's competitors who use IBM equipment frequently find themselves discriminated against by IBM—i.e., they do not require the same services as do other IBM customers, but, they still must pay for such unused products and or services due to semi-bundled prices.

(f) Pricing Advantage Due to Size of IBM

Due to the size of IBM's market base, they have a pricing advantage over competitors. The cost of a software (or hardware) product can be initially

spread out over such a large potential base that a unit price can be set at a low enough level to exclude competition.

VERTICAL VS. HORIZONTAL SEPARATION

ADAPSO/SIA does not believe that the classical anti-trust relief of dividing IBM into several computer hardware companies (i.e., a vertical break up) will be to the short- or long-term benefit of the public, of other users of computers, or of the software products industry.

This proposed vertical restructuring of IBM could result in incompatibility between IBM computer hardware and software and also in increased costs in the overall development of software products. Therefore, ADAPSO/SIA recommends, as an alternative structure to reduce IBM's influence over and share of the computer market, that IBM be separated into at least two organizations—a hardware organization and a software products/services organization.

Since IBM now controls the software products and services markets, ADAPSO/SIA further believes that the Justice Department must place special safeguards and restraints on IBM to prohibit their continued control over these markets.

PROPOSED RELIEF

If the Justice Department and the Government expect to improve and simplify the operational use of computers and to reduce the costs of programming for Government users and the business world, the following steps must be taken:

1. IBM may not directly or indirectly tie in its hardware and software marketing efforts. To that end, IBM must be required to separate its software development and marketing so as to be separate and independent from its hardware operations.
2. All IBM software, both existing and planned, must be priced on a basis which yields a return and reflects all associated costs, separate and apart from its hardware.
3. Safeguards must be implemented to insure that a competitive software industry, once established, will remain outside the domain of IBM. One such safeguard would be to require that the entire new IBM software organization receive information on new IBM developments only at the same time that it is released to independent software companies.
4. The IBM software organization would be required to release comprehensive software interface specifications to all interested independent software companies at the same time it releases it to its hardware organization.
5. Neither IBM nor its software organization should be allowed to announce any software products prior to availability for general use.

SEPARATION OF THE IBM SOFTWARE ORGANIZATION FROM THE IBM HARDWARE ORGANIZATION

The new IBM software organization should be separate from the IBM hardware organization as follows:

1. Separate physical equipment purchased on an "arm's length" basis from any manufacturer, with no favored terms and conditions.
2. Separate physical facilities.
3. Separate personnel, with no standardized policy of transfer or promotion between organizations.
4. Separate accountability published and made available to the same extent as would be produced for a completely separate public corporate structure.
5. Separate name, which is not identified with IBM for advertising or marketing purposes.
6. Prohibited preferential references or recommendations to third parties by either organization, except on an objective basis fairly reflecting competitive terms and conditions.
7. No advances of capital or loans between divisions, except on terms available generally to third parties.
8. Exchange of services and products between divisions only on the "arm's length" basis as available generally to third parties.

THE 1956 CONSENT DECREE

ADAPSO/SIA believes that the Justice Department can quickly develop a competitive software products industries by applying the principle of the 1956 Consent Decree which states in part:

IBM is hereby enjoined and restrained from conditioning the sale or lease of any standard tabulating or electronic data processing machine (which shall include any machine unit on a separate base even if in normal use it is mechanically or electrically connected with another such machine unit) upon the purchase or lease of any other standard tabulating or electronic data processing machine.

Electronic data processing machine shall mean a machine or device and attachments therefore used primarily in or with an electronic data processing system.

Standard tabulating machine or standard electronic data processing machine shall mean a tabulating machine or an electronic data processing machine manufactured by IBM and made generally available to its customers.

IBM's own senior patent attorney spoke of the interchangeability of hardware of software in the following public statement.

First, in some respects computer programs and hardware are interchangeable; hence one can say that a new computer program is similar to a new machine.

ADAPSO/SIA respectfully insists that the principles of the 1956 Consent Decree be enforced relative to IBM's current and previous practice of tying together the software machine and the computer hardware machine.

In summary, we believe it is imperative that the Justice Department bring all legal weapons to bear in order to develop a competitive software products industry.

Attachments: (4).

Attachment 1

ADAPSO SEEKS PERMANENT EXCLUSION OF IBM FROM DATA CENTER ACTIVITIES

New York, N.Y., February 26, 1973—The Data Center segment of the Association of Data Processing Service Organizations (ADAPSO) called for the permanent exclusion of IBM from the data center business in its position paper released today dealing with the government's anti-trust litigation against IBM.

Two position papers were devised representing the views of the industry from ADAPSO's Software Section (Software Industry Association) and the Data Center segment. The major thrust of the software position (released February 14, 1973) was to insure fair competition in the market place by recommending to the government the separation of hardware from software in the IBM Corporation through the technique of "maximum separation."

The ADAPSO Data Center Section position calls for the formalization, through the courts, of IBM's voluntary withdrawal from the data center business for six years and that the courts make this decision permanent.

Further, the position requests that IBM's exclusion from the furnishing of data center services is complete, eliminating the opportunity for a "back-door" reentry into the data procesing services industry.

The Association of Data Processing Service Organizations (ADAPSO) founded in 1961 represents more than 650 firms and branches offering computer products and services.

Attachment 2

DATA CENTER SECTION—STATEMENT OF POSITION APPROVED: FEBRUARY 2, 1973

The data center segment of the computer industry was in large part created as a direct consequence of the entry of the 1956 antitrust consent decree against IBM Corporation. That decree separated out IBM's data center services business into a separate corporation, Service Bureau Corporation (SBC). The decree was twice modified thereafter and continues in effect. Although separation of IBM's data center services from its other businesses was not complete and some tie-ins persisted, separation has accordingly been a characteristic of the independent data center segment from its inception and "tie-ins" and economically unjustified joinders of activities have therefore presented a relatively lesser problem to it than to other segments of the computer industry.

For whatever reason, the effect of the recent private settlement by IBM of the antitrust litigation against it by Control Data Corporation (CDC) has been to completely sever IBM's data center business from IBM by transferring it to a competitor, CDC. The data center segment believes that this transfer should resolve the special tie-in problems of its segment, provided that (a) the complete separation is formalized by court decree, so that it is not subject to later change by private action (b) it is made permanent and not limited to the six years which IBM has consented to stay out of the data center segment and (c) it is made clear that IBM's exclusion from the furnishing of data center services is

complete and includes commercial and scientific data processing services; batch processing; remote job entry processing; timesharing services; data preparation services; and facility management operations. Such exclusion should also prohibit the supply of any support activities which would, in effect, represent a "back door" entry into the data processing services industry.

Attachment 3

STATEMENT OF GENERAL POSITION

The Association of Data Processing Service Organizations, Inc. (ADAPSO) is the trade association of the computer services industry. It is composed of 661 data centers, software houses, time-sharing organizations, facilities managers and other vendors of data processing services and software products. It presents this Statement of General Position with respect to the competitive structure of the computer services and software products industry for the guidance of the Justice Department in the pending Government litigation against IBM Corporation, as well as the Congress, the computer industry and the public at large.

1. ADPSO regards the linking together of separate products and activities of IBM and other computer manufacturers as constituting the fundamental anti-competitive computer industry problem. It believes there are no economies of scale which would preclude free and fair competition in the computer industry, were it not for such joinder. This Statement of General Position therefore urges the elimination of "tie-ins" and economically unjustified joinders in whatever form. It will be followed by independent Statements of Position by ADAPSO's separate Sections (Software issued February 14, 1973; Data Center's Position enclosed) furnishing their recommendations as to how such joinders may be eliminated in their industry segments.

2. In addition to the special and in some respects unique interests of its Sections, however, all ADAPSO members are also users of computer hardware. ADAPSO therefore joins in the overall efforts of the Government to bring free competition to the hardware industry by way of such remedial action as will be in the interest of the user public generally.

3. Reluctantly ADAPSO must also advert to a procedural matter of overriding importance, because without its resolution there may be no timely anti-trust relief at all. To this point the resources devoted by the Government to the prosecution of its antitrust litigation against IBM Corporation have been inadequate to the task. That suit is now over four years old, but pretrial proceedings have not yet been completed nor any trial date set. The inadequancy is perhaps best epitomized by the Government Staff's need to rely for a large part of its discovery on the preparation conducted by Control Data Corporation (CDC), a party to private antitrust litigation involving IBM, desptie protests of the Court and many private interests including ADAPSO.

The vice of such unprecedented Government reliance upon private interests has just been demonstrated by the alleged destruction by CDC of important trial preparation materials. Government counsel has asserted that the effect of the destruction will be to hinder and delay preparation of the instant case for trial.

ADAPSO calls on the President, the Attorney General and, if necessary, the Congress, to make available and allocate adequate human and financial resources to the prosecution, to insure that the case will be brought to final judgment at the earliest possible time, with the Government's case being fully and properly prepared. Only in this way can we be sure that the interests of all parties, including the public, will be adequately represented.

Attachment 4

POSITION PAPER ON THE INCREMENTAL MARKETING OF COMPUTER SERVICES AS AN UNLAWFUL TIE-IN SALE

Statement of Position

Coercion should be presumed and an unlawful tie-in held to exist, whenever a seller marketing a product in a separate line of commerce also markets a not insubstantial volume of computer services, and where the following circumstances are present:

1. The first (tying) product is patented or copyrighted, or otherwise a lawful monopoly of the seller.

2. There exists some special relationship between the seller and the purchaser which is independent of the particular purchase-sale relationship giving rise to the questioned transaction, such as by way of dealership, franchise or license.

3. The seller offers its computer services only to those purchasing the tying product and not generally.

4. The tying product is important to the business of the computer services organizations in the pertinent market.

5. The seller is of large size relative to the computer services organizations in the pertinent market.

6. The seller operates in an oligopolistic or monopolistic line of commerce.

The number of these circumstances necessary to justify the presumption will vary, depending on the facts of each case. Thus, where 4, 5, and 6 are present, as in the case of communications carriers and banks, 1, 2, and 3 are not required. The existence of all six should never be necessary.

Discussion

ADAPSO welcomes and encourages fair competition in the computer services industry from any source—conglomerate, congeneric, manufacturers' subsidiary and independent. However, that competition must be fair.

ADAPSO has fought competition from subsidiaries of communications common carriers and from banks, because of its deep concern about the inherently coercive character of their cross-market activities. It intends to continue its fight to insure that the computer services industry remains competitive.

Cross-market operations, however, are by no means restricted to banks and communications carriers. They are increasingly becoming a feature of the computer services industry. This is because more and more organizations whose principal products are in separate, non-computer services lines of commerce, find themselves with large amounts of "idle" or "excess" computer capability, created by the inhouse capacity considered necessary to handle peak loads during limited periods of maximum operation. Moreover, frequently such companies can expand computer capacity over a given base quite cheaply, and are thus tempted to do so and market the overcapacity. The computer services industry therefore becomes an obvious and attractive target for their cross-market expansion.

Restrictive cross-market impact by organizations such as banks, communications carriers, computer manufacturers' subsidiaries, charities and government organizations, has accordingly for some time been a special and perhaps key concern of the computer services industry. The mere threat of cross-market competition can be sufficient to discourage a budding computer services industry entrepreneur. This is because he knows that cross-market operator sometimes price their public offerings of computer services on an incremental cost basis—that is, so as to recover only the incremental costs of the offering plus whatever contribution to fixed costs is possible, but not all fixed costs allocated on an overall product basis, plus profit.

In contrast, at least at the inception of his business, the computer services vendor has only a single product line over which to spread his fixed costs. He does not have a ready and sometimes "captive" market to cover his "nut" (break-even costs). In certain types of offerings, particularly of time-sharing services, he has huge start-up costs to recover. He needs potentially large profits to attract risk capital. Obviously he cannot expect to meet the competition of the cross-market operator by pricing his services on an incremental cost basis.

Price competition is of course a cornerstone of American industry and enterprise. If the cross-market operator has advantages of scale or otherwise and can outperform his computer services rival without restraint of trade or other unlawful act, present law permits him to do so. Under the special circumstances presented by the computer services industry, however, this conclusion often begs the real issue, which is an evidentiary one.

The question of whether there in fact is restraint in cross-market operations involving computer services can be an extraordinary difficult one to answer. Its resolution can take so long as to preclude remedying the wrong within a meaningful time frame. The intimate relationship between the two products being sold and the esoteric nature of the computer services transactions may be very intricate. For example, how should one cost-allocate the use of an idle computer required for standby or to handle a peak load, or the development of a necessary in-house program redesigned in minor part for marketing purposes? As a result, obtaining and analyzing the evidence necessary to establish the most common

and pernicious form of restraint by the cross-market operator, the "tying" arrangement, can take years of litigation and enormous expense. "Tying" arrangements have long been held to be *per se* unlawful by the United States Supreme Court, because they force the public as buyer to forego its free choice between the competing "tied" products and deny competing suppliers free access to the consuming market of the tied product. The Supreme Court has said that "the vice of tying arrangements lies in the use of economic power in one market to restrict competition on the merits in another."

Prohibition of cross-market computer services transactions under the described circumstances need not deny the consumer the benefits of competition from these services. The cross-market operator has only to remove the coercive tie-in aspect by applying the now recognized "maximum separation" principle. The public and the cross-market operator are thus not denied any advantages or benefits from scale—which are often small and sometimes non-existent in the computer services industry—but simply the marketing leverage which results from the cross-market relationship and the "full line" approach.

The independent (of IBM) computer services industry was conceived in the filing of the United States Government's antitrust complaint against International Business Machines Corporation in 1952. It was born with the consent decree entered in that litigation in 1956. It is thus a very new one. It promises to be huge—far bigger than hardware. It "bundled" computer statistics are broken out fully, to include operating systems, software may already be a bigger business than hardware.

To this point the industry has been structured along classical free competition lines. It is fragmented into a great number of small economic units. It is characterized by ease of access to many parts of the market, as well as demise from that market. It is highly competitive, but sometimes the competition is cutthroat and destructive. It may have its modern Horatio Alger stories, but it also has disasters.

Because it is new, highly competitive, esoteric, complex, developing at a rapid pace and endangered, the computer services industry requires protection against the cross-market tie-in threat. The dangers of cross-market activities are apparent. Under the described conditions, the power to coerce is clearly present. The problem of proof is great. The industry should not be made to wait the generation of legal precedent ordinarily needed to establish a factual presumption; by then it could be too late to preserve the computer services industry's present highly competitive state. Recognition of a presumption of coercion in connection with the computer services crossmarket tie-in sale by the courts, now, is necessary and proper, and should be made to wait no longer.

Exhibit 3.—*Letter From American Satellite Corp. Re Anticompetitive Effects of Proposed IBM-Comsat Joint Venture*

AMERICAN SATELLITE CORP.,
Germantown, Md., August 5, 1974.

SENATE COMMITTEE ON THE JUDICIARY,
Subcommittee on Antitrust and Monopoly,
Washington, D.C.

DEAR MR. HELLERMAN: It is our understanding that the Senate Subcommittee on Antitrust and Monopoly, in connection with its review of the extent of competition in several different industries, is presently considering various aspects of IBM's position in the computer market and its relationship to the computer related products market.

We wish to call to the Subcommittee's attention a recent development in this area of interest: the announcement of IBM of its intention to enter the domestic satellite arena as a co-venturer of COMSAT. It is our conviction that such an entry will have significant anti-competitive effect upon the computer industry, the computer related products industry and also on the domestic satellite industry. Accordingly, we urge the Subcommittee to include this proposed venture as a part of its overall review of IBM.

To assist the Committee in this review, we submit the attached memorandum indicating, to the best of our understanding, the mechanics of the proposed entry and what we believe will be the inevitable anti-competitive effects of such an entry.

Very truly yours,

JOHN D. JACKSON.

Attachment.

Anti-Competitive Implications of the Proposed IBM/COMSAT Joint Venture

IBM, COMSAT (together with its wholly owned subsidiary COMSAT General), and CML (a company presently jointly owned by COMSAT General Corp., by Lockheed Aircraft Corp., and by MCI Communications Corp.), have filed a petition with the FCC to permit the entry of IBM into the domestic satellite business. It is proposed that IBM will acquire 55% of the stock of CML and that COMSAT General will increase its stock ownership in CML from 33⅓% to 45%.

ASC believes that the proposed IBM/COMSAT venture will have significant anti-competitive effects on the domestic satellite field, is a violation of the anti-trust laws and should be of serious concern to the Subcommittee. It is the purpose of this memo to briefly set forth the potential anti-competitive effects of the IBM/COMSAT venture.

As a stock acquisition the venture is, of course, subject to Section 7 of the Clayton Act. The markets affected by this acquisition and in which competition may be substantially lessened are domestic satellite (Domsat) communications (especially the market for high speed data transmission by satellite); computer interface and peripheral products; and computers themselves.

As the Committee is aware from its consideration of the communications marketplace, the Domsat market has a very limited number of participants. In 1972 the FCC approved entry by AT&T, by CML (as presently organized), by ASC, by Western Union Telegraph Co., by a joint venture between Hughes Aircraft Co. and GT&E Services Corp., by Western Tele-Communications, Inc., and by Radio Corporation of America. As the market is presently structured, AT&T will be the sole provider of interstate switched voice message traffic and is authorized to utilize satellite transmission service provided exclusvely by COMSAT. While GT&E initially received approval to compete aganst AT&T in this area via satellite, it has now—following litigation by AT&T—proposed to combine its system with that of AT&T and to utilize the same satellite transmission services provided by COMSAT. Approval of that plan would nullify the previously proposed and FCC-approved entry of GT&E and Hughes as a joint venture.

In its 1972 Domsat decision, the FCC imposed a restriction on the AT&T–COMSAT arrangement and on GT&E precluding their extension of satellite systems beyond their existing regulated monopoly business—switched voice message traffic—for a period of three years from their date of first satellite operations. This restriction will probably expire in the late 1970's, the same time frame for the proposed IBM/COMSAT entry.

Western Union will have as its base traffic its monopoly market, the transmission of various forms of record messages; RCA will similarly have some base traffic—switched message traffic to and from Alaska—where RCA is the monopoly common carrier.

The basic marketplace for competition among Domsat entrants, as established by the FCC, is the provision of services other than monopoly telephone and record communications, i.e., the *private line* transmission of voice messages, video signals and data. All FCC-approved entrants other than AT&T and GT&E will be permitted to provide private line service from the outset. The only FCC-approved entrants without some monopoly—related base traffic—that have entered or may actually enter that market are ASC and CML.

There are other potential entrants into the private line satellite market, even though the technological and financial requirements for entry are substantial. IBM is a likely potential entrant because it is the dominant firm in the manufacture of data processing equipment and because the high speed transmission of data generated by that equipment will, in the not very distant future, be a principal kind of communications carried via domestic satellite.[1]

The method chosen by IBM to enter the Domsat market—a stock acquisition and joint venture with COMSAT—eliminates IBM as a separate entrant or as a joint venturer of a competitor of COMSAT. Furthermore, it eliminates two lesser entrants, Lockheed and MCI, who are authorized co-venturers of COMSAT. This elimination of potential competition, both actual and perceived, is prohibited by Section 7 of the Clayton Act.

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[1] From a technological and economic point of view, the most important long-term market open to Domsat entrants not possessing a monopoly traffic base is the high speed transmission of data. The existing terrestrial communications networks of AT&T and other carriers cannot provide efficient long-distance transmission of data at speeds above 9.6 kilobits per second. Communications satellites—coupled with modern technology in earth station and interface hardware—will economically transmit data at speeds far in excess of 9.6 kilobits per second over any distance, including coast-to-coast.

This acquisition will, moreover, have very substantial anti-competitive effects beyond elimination of potential competition. We believe it extremely probable that this acquisition, together with IBM's dominant position in the computer market, will permit IBM to develop an end-to-end, highly sophisticated, domestic communications system tying together a substantial portion of the nation's computer capacity. This probability is heightened by IBM's current development of time-division-multiple-access devices and related equipment which will permit one operator, if it has its own satellite communications capability, to link a substantial portion of the computers in the country on a time-sharing basis. By the time such a system is operational the temporary ban on participation in data services which IBM accepted in the *Control Data* case will have ended. The joint venture with COMSAT will, in the meantime, "freeze" the market and serve to prevent the development of competing systems. It will, in the long run, assure that IBM's dominance in computer hardware can be used to achieve dominance in interface hardware and high speed data transmission by satellite.

With end-to-end capability, IBM will be able to offer a package of computers, interface hardware and communications. It will be able to offer such a package at such times and in such configurations as to suit its overall advantages over its competitors in each market and it will enable IBM to price and manipulate communications, interface hardware and computers in such a way as to stifle entry and competition in each market. The Government has, among other things, accused IBM of quoting a single price for related packages in order to foreclose competition. Paragraph 20(a), Complaint, *United States* v. *I.B.M.*, Civ. No. 69 Civ. 200, S.D.N.Y. Whether IBM does or does not actually quote a single price for these products and services, it will enjoy the benefits of package selling, an advantage which will be shared with no competitor in any of the affected markets. If this sort of competitive advantage may have substantial anti-competitive effects, Section 7 prohibits its being obtained by acquisition.

IBM also has the ability to design its computers so as to make it impossible, or exceptionally difficult, for competitors' peripheral equipment to interface with them. The proposed acquisition will give IBM an opportunity to use this means to prevent competitors of the IBM/COMSAT venture from selling to customers using IBM machines. The IBM/COMSAT joint venture will thus have the power to effect a foreclosure of a very substantial part of the high speed data transmission market, and an important part of the Domsat market. An acquisition that confers power of this magnitude violates Section 7 *prima facie*.

There are other anti-competitive effects of this acquisition that warrant consideration:

Research and Development—IBM and COMSAT are among the country's leading companies in research and development. Their combination will preclude the probability of their competing in R&D on interface hardware. Furthermore, the combination will stifle technological advances in satellite, interface and computer technology at least until the time of their actual entry in the Domsat market. After such entry, the IBM/COMSAT venture will discourage the adoption of technological developments which would render any of their products obsolete.

Computers.—If high speed data transmission technology advances as presently projected, computer purchasers and users will become increasingly dependent upon Domsat communications for efficient utilization of their computers. If IBM is permitted to enter the Domsat market and undertakes to market an end-to-end product, it is extremely probable that its share of the computer market will increase. Such further concentration will only exacerbate the already existing dominance of IBM in that market.

Financial Barriers to Entry.—The financial barriers to entry into the Domsat market are already high. With the entry of IBM especially in combination with COMSAT, the possibility to small and medium companies securing outside financing for that entry will be extremely remote.

Entrenchment of COMSAT.—At the present time, COMSAT is the dominant company in the communications satellite market. The addition of IBM will bring COMSAT immense market power and will entrench COMSAT's power in this market. Such entrenchment violates the Antitrust Division's Merger Guidelines and is violative of Section 7 of the Clayton Act.

Sherman Act.—This combination of companies, each dominant in its own sphere, may also violate Section 2 of the Sherman Act as a combination to monopolize the market for high speed data transmissions: a principal market to which Domsat entrants, like ASC, must ultimately look if they are to be successful.

As pointed out above, IBM's dominant position in computers can be used to foreclose competition in high speed data transmission. COMSAT brings to the joint venture its dominance in satellite communications, which is in all cases the optimum and in many cases the only method of high speed data transmission. IBM brings a means to exclude others from the business. A combination of this sort achieved by stock acquisition is clearly prohibited by Section 7 of the Clayton Act. It seems, further, to be almost a classic combination or conspiracy to monopolize, in violation of Section 2 of the Sherman Act.

The issues raised by this proposed venture are significant and far-reaching. If approved, the venture will have a major impact on the Domsat, computer, and computer interface and peripheral markets. It is a matter which should be reviewed by the Subcommittee in connection with its investigation of the communications and computer industries.

AFTERNOON SESSION

Senator HART. The committee will come to order.

Our opening witness this afternoon will be Mr. Thomas Parkin, vice president of software, Control Data. It's my understanding that Mr. Parkin will demonstrate and explain, if that is the right word for it, what a computer is, how it works, and give us some practical examples.

We are appreciative of the cooperation of the corporation for making Mr. Parkin available for what we call an educational purpose.

You may proceed, sir, in any way you desire.

STATEMENT OF THOMAS R. PARKIN, VICE PRESIDENT, SOFTWARE, CONTROL DATA CORP., MINNEAPOLIS, MINN.; ACCOMPANIED BY EARLE L. LERETTE, SPECIAL ASSISTANT TO CHIEF EXECUTIVE OFFICER

Mr. PARKIN. Thank you, Senator Hart. Thank you very much for the privilege of being here to tell you about computers.

I'm personally very bullish on computers. My preparation for this meeting is 25 to 30 years of involvement with computers since slightly before there were any, and I really am personally quite enthusiastic as a technologist about computers.

I'm not here to have anything to say about your main issues, but hopefully to provide some background and help dispel some of the aura of omnipotence computers have achieved.

I'm here with Mr. Lerette who is the special assistant to our chief executive officer, Mr. Norris, and after my initial remarks he'll show you some samples, which we'll pass around.

It's our intention today to try to talk about the three points shown in figure 1, and I'll interweave the talking about these into one continuous narration, because if one tries to explain what is a computer and how does it work and how are they used as separate topics it becomes quite confusing.

[The figures referred to throughout Mr. Perkin's narration appear as exhibit 1 at the end of his oral testimony.]

Mr. PARKIN. We've all heard about computers. We've felt their impact on our daily lives. We see their effect in billing, in all sorts of fantastic articles in the paper about how a computer made a goof. Well, perhaps if we look inside a little bit, we may get some understanding of how a computer works and you'll observe that it is not a computer that ever makes a goof; it's the people who use it and the people who write programs for it.

At the end I expect to make a few remarks about the future of our technology, but if at any point through the talk you wish to interrupt for a question, please do so.

To give you some initial impression of a computer I've shown you a picture, figure 2, which is an installation of several component parts and we intend to discuss these parts one at a time so that you'll see how they interrelate what the individual pieces do and what is a computer.

Figure 2 is a computer system installed in a special room of its own with a fancy subfloor with air-conditioning; a very tidy piece of machinery. It's not like a rolling mill. It's a place where people work.

A computer basically exists in a system as shown in figure 3. Without being in a system a computer doesn't do much. By itself a computer is just a glorified desk calculator, but when you imbed it in a system, that is, you make available to it storage media, like tapes and discs, input media, like card readers, and remote access capability like terminals and teletype units, or line printers, then it becomes a system which is capable of doing some useful work. We'll examine how those pieces of the system fit together.

There are many things a computer is not. A computer is not an anthropomorphic entity with intelligence of its own. It's really a very high-speed calculating machine.

It can do exactly what you tell it and it can do that very rapidly, but that's all it can do; just exactly what you tell it. It's quite literal minded as noted in figure 4. You don't say, pound a nail. You say, pick up the hammer by the end which is round and raise it up and push it down. It's a series of very, very miniscule steps of instruction that one must give a computer to make it do something.

Let's look at the five basic functions of the computer shown in figure 5. It really is just an electronic machine to do those five things. It takes input in. It stores it. It performs arithmetic on it through a control mechanism, and it provides output. That's all a computer does. In any of the many, many thousands of installations of computers, that's all any of them do just those five basic functions. They may become incredibly complicated, and we'll see some examples of this, but the essence of it is simplicity itself.

Again, I emphasize the five basic functions of the computer, shown in figure 6, because we're going to be talking about each one of these and how they work together and how they correspond to similar functions in man.

Man performs input functions by sight, taste, touch, smell; the kinds of things that you know how to do; you have that feeling of gathering from your senses the input from your environment as noted in figure 7. A computer does it by means of punched cards, push buttons, mag tapes, punched tapes, keyboards, all kinds of electronic and electromechanical sensory devices as noted in figure 8.

For example, figure 9 is a typical punched card, made very famous by the company of my distinguished predecessor, Mr. Katzenbach. This is the famous IBM card, as everyone calls it. It's a standardized card which has rows of holes in it, punched in it, in a rectangle array. There have been various attempts in the past to make those round but they haven't caught on. The rectangular hole is the standard and the various combinations of holes tell you what letter is punched in a particular column.

For example, in the very first column there's a punch in the top row and a punch in about the fourth row down and that means an "A," and a punch in the top row and the fifth row down is "B," and so on.

So each of the characters that you wish to get input into a computer will get punched into a card like this, in general. Not all input goes this way but by far the vast majority of input to computers is through punched cards.

Figure 10 is a card reader. The instrument in front is the card reader and you can see a small stack of cards at the lefthand side of that card reader. In the background is a computer. That card reader is capable of reading 1,200 of those cards a minute, and it reads them through a very high-speed mechanical motion of the cards. The cards are stacked on the other side. And that's one means of getting input into a computer.

Figure 11 is a disk pack. A disk pack is another form of input device. It is frequently used to accumulate a large number of card images and characters from card images and then the disk is put onto the machine and read in as the input medium. The disk pack is a series of little platters that look somewhat like phonograph records. We'll see another view of that a little later.

Figure 12 is an example of a man working at a console. This is the keyboard type of input, which is really quite slow and hardly used except in some control situations.

Occasionally, large amounts of data are recorded on magnetic tape and that becomes an input device.

Figure 13 is a row of magnetic-tape units. The operator is mounting one of the tapes. They're threaded on from one reel to the other and read at very high speeds by the transport mechanism; much higher speeds than your home tape recorder.

Figure 14 is an operator adjusting an optical character reader for reading documents. This is a much more sophisticated kind of device which is beginning to become available. The character readers for optical character reading today generally require special fonts; not always, but generally. For example, printed on the bottom of your bank check you'll see a strip of characters that looks rather odd. Those are both magnetically readable because they're printed with magnetic ink and they're also electronically readable by optical scanning because they have that peculiar shape. Optical character readers are just beginning to become widely used as an input mechanism. They certainly are faster than punching cards.

Figure 15 is bank teller terminal which is currently becoming the vogue for some banks. It's gradually spreading because it makes the banking mechanism much faster from the bank's point of view, much more accurate, and provides a better service to the customer. Incidentally, service to customers is the fundamental mechanism which drives the usefulness of computers. They provide a better service, ultimately, to a customer, or else they're not being used.

Figure 16 is a ticket terminal which is a device which is beginning to be used. You'll find them in the Washington subway system when it starts in operation, for example. You'll find them in off-track betting situations in States which allow lotteries and some horseracing. They're being used around the world, also, in numerous applications.

Figure 17 is a kind of terminal which is in use occasionally in medical situations. The technician is just touching the front panel of the display and the computer, by analyzing which pad was touched, can tell what input was intended. Typically, a set of questions or statements is put on the screen and the technician selects which statement she wishes to have applied and then it gets recorded by the computer.

In some situations we have rather esoteric equipment becoming available. For example, figure 18 is a device which can simultaneously monitor a number of bodily functions for a patient. Those data are digitized and fed directly to a computer for recording, for analysis, and for observing trends to see whether the blood pressure or whether the temperature rates are within the norm.

Figure 19 is an even more sophisticated example of an automatic machine to do analysis in the laboratory of serums and blood tests. Here the machine is doing the chemical test and automatically digitizing the data, feeding it to a computer for storage and analysis and subsequent printout on the patient record.

Thus we have seen a number of examples of computer inputs which fits the text shown on figure 20. But, all a computer can operate on is numbers. Everything else is data which becomes converted to numbers in some form. The data can be letters, symbols, dimension, measurements on a drawing, the length of a bar; whatever information is necessary to go into the machine—but at some point it gets converted to a number.

It doesn't become meaningful inside the computer until it's in a number form we call digital, meaning exactly what it comes from, the digits of the hand indicating the way we count. The digital system in use in computers is the binary system. We'll come to that in just a moment.

For the time being I want to talk about storage because a computer doesn't become interesting and useful until it can store things. Figure 21 reminds us that man does storing by memorizing and by making notes and by looking up things in books. Figure 22 shows us that a computer does storage by a large number of different techniques.

Basic electrical circuits for storing information have been in existence for about 30 years. Magnetic drums, magnetic cores, and magnetic tapes are all mechanisms for storing information which are more or less accessible at different speeds. Figure 23 notes that storage contains three kinds of important things. It contains numerical data, the kinds of letters and symbols which people communicate with the computer, and the instructions for the computer.

Parenthetically, we should note that storing instructions in the memory of the machine is the technique which made the digital computer a significantly more powerful instrument than anything else that had ever been invented by man before. This was a contribution made by a friend of mine, Johnny von Neumann. He basically came up with this essentially simple concept that said store in the computer the instructions to tell the computer what to do and let the computer also operate on those instructions as well as operate on numbers. That was a profoundly simple concept which changed the course of history because, previously, controlling of complex computing machines was an incredibly difficult and time-consuming proposition.

Instantly he put the power of the computer to work to provide its own control and that is a profound breakthrough in the annals of human endeavor.

Let me talk a little more about the concept of memory locations that have addresses. Let us look at figure 24. There is a distinction, you see, between the number on the box and the contents of the box. A memory location in a computer has an address—it may be a location number 8, but location number 8 doesn't contain the number 8. It contains something—a string of characters or a decimal number or an alphabetical set of symbols. The contents of an address and the address are two completely different things and they are a very difficult piece of the total concept of computers to keep in mind when beginning to learn the subject of programing. All beginning programers have trouble with this. Figure 25 is an example of a surface of a magnetic drum. The whole surface of it may have millions of bits of information recorded on it but each location on that drum, or certain symbolic locations on that drum, will have addresses. For example, the address you may want to go to is location 1,012; the contents of that address may be a name, it may be a piece of payroll information, or it may be a piece of data of any kind that's significant to that use of the computer.

Magnetic cores developed fairly early in the computer act as a storage mechanism, and later on I'll show you some samples of magnetic cores.

Figure 26 shows that it's a string of these cores—a number of them—which comprise a location in storage. A single magnetic core stores a single bit—and I'll try to explain what a bit is—but the important point is that it's a set of those bits that comprise a storage location. In the case of magnetic core storage we may have several planes of storage and a single thread through all those planes will give you a single word or location. Such a location has an address but the contents will be determined by the bits of storage.

Now, one bit of storage is a simple yes or no. It's a one or a zero. It's an on or an off. All a magnetic core can store is just that one bit of information and if you wish to store more, let's say a thing called a byte, say six bits or eight bits comprising a byte, then you must have six or eight individual bit storage elements; or if you want to store a 24-bit word, or a 60-bit word, or some other size word of information in the machine, then you have to have a core, a one-bit core for every one of those bits as shown on figure 27.

Figure 28 shows us a bigger view of the magnetic core. It shows the way they're threaded together. A magnetic core is like a doughnut, but incredibly small. These days the smallest ones are smaller than the head of a pin, and through those cores they string two wires like this, and in addition they string a third wire which goes through all of the cores at the same time. That third wire is called the sense line.

In order for that information stored in that core to be known, the core is magnetized. It's a piece of magnetic material which is magnetized. It's either magnetized in the righthand direction or in the lefthand direction, and if that core is magnetized one way, it's a one; if it's magnetized the other way, it's a zero.

The way we get the information out of that core and the way we find it is to put half of the amount of current through one of those wires that it takes to turn that core over, and half the amount through

the other wire, and it's only the wire at the intersection of those two points as shown in figure 29, that will be affected. The third wire, which you don't see on the drawing, which threads through all the cores, will get an impulse at the instant that that core turns over. It'll get a one or a zero type of impulse.

Figure 30 reminds us that memories are often thought of in a hierarchical form. The core, or what is coming to replace cores nowadays, the semiconductor memory, is really the fastest and the most expensive. Drums are quite fast, but an order of magnitude or so slower and so it goes down the chain of speed versus size. The bigger the size of memory the slower the access to that memory in general.

This is a disk pack and you can see the removable aspect of it. In that little container held in the girl's left hand is the stack of disks which are like phonograph records. They come in various sizes but that one typically happens to be about 5 inches high, and about 12 or 13 inches in diameter. It's easily transportable and you can store such disks on the shelf and put them on a thing called the spindle which is the drive mechanism which rotates them and some arms come in from the side to read them, much like a phonograph needle reads a phonograph.

Another example of storage mechanism shown in figure 32 is the tape unit. Here a tape is being mounted on a tape transport. Figure 33 is an artists rendition of an optical character reader device. They are becoming somewhat more prevalent, as I mentioned earlier, and I personally think that they will become an exceedingly important aspect of our technology.

Figure 34 shows the basic hierarchy of costs associated with memory. The main memory of a computer might cost something on the order of 20 cents a bit and be accessible in one-millionth of a second; and so it goes through the different mechanisms. The access time for a tape might be 10 seconds, the access time to a disk is only a hundredth of a second; and you can see the time getting smaller as the cost goes up. Obviously there's a tradeoff between how much of any one kind you can have in your system, and it's the management of these hierarchies of memories which comprise a good deal of the intricacy of a computer system.

Figure 35 shows us that both man and computers perform the function of arithmetic. People do it by counting on their fingers or by figuring on a piece of paper. These are the simple arithmetic calculations which you've learned in school.

The whole mechanism of counting stems from the Egyptian and Roman times and earlier when a whole variety of number systems were invented. Figure 36 shows two early systems.

Modern computers use what is called the binary number system. You'll see a series of decimal numbers on figure 37.

For example, the decimal number zero is represented by three binary digits, the digits zero, zero, zero, and the number 5, for example, is represented by a one, zero, one. There are a set of eight possibilities for those three binary digits, ranging from three zeros to three ones. So, clearly, three binary digits is not quite enough to represent a full range of decimal numbers. It takes four binary digits to do what we call binary coded decimal arithmetic. That is to say, for each item that we wish to add, we have to deal with four binary digits.

But four binary digits will carry you up to 16 so there's a certain amount of overlap and a crtain amount of built-in confusion which has existed in this industry since day one; built-in confusion because man wasn't born with four fingers on each hand. Had we been, we would have counted in the octal system instead of the decimal system and it would have been somewhat more straightforward to be in the computer world.

This particular confusion now causes us sometimes to deal with binary numbers, octal numbers, hexadecimal numbers, those based on 16, or binary-coded decimal numbers, those based on, say, four binary digits representing a decimal number, and many combinations in between. In fact, the variety of combinations is slightly greater than the number of companies in the business because many companies have two or three versions of codes that cause endless confusion.

When we were in grammar school we learned how to do arithmetic with two kinds of tables. We learned how to add by memorizing an addition table. We learned how to multiply by memorizing a multiplication table.

It might have looked a little bigger when we were looking at it as kids, but basically, figure 38 shows the sets of numbers we had to learn.

You memorized them. Nine and eight is 17. Six times five is 30. You had to memorize that set of numbers. There's quite a few of them, actually, a total of combinations.

In contrast, figure 37 shows us that the binary number system is really rather simple. Addition consists of those four numbers shown. When you add any one on the left to any one at the top; you get the number in the box at the intersection. Similarly, multiplication consists of four possible results, three of them zero and one is a one. So in the binary number system addition and multiplication are very, very simple and that's why it has become the basis for the construction of computers. There are only eight total combinations and one can build electronic circuits to do that simple arithmetic. It would be very difficult and very expensive to build electronic circuits to do arithmetic on the base 10, so we just don't do it. All computers work on these basic binary digits.

Figure 40 is an example of the addition of numbers. You will notice the binary columns add just exactly like the columns of a decimal number, with carry, and that particular addition sum is correct, both in decimal and in binary.

Note the three binary digits, of zero, one, zero, which means a two, and zero, one, one, which means a three. You just add one column at a time and carry over to the left just like you do in decimal arithmetic and you get the result five, which is one, zero, one.

Now, we want to talk some about computer instruction because arithmetic is pretty simple. What makes computers complicated? The basic thing that makes them difficult to deal with, but at the same time gives them their enormous power, is their instruction capability. Figure 41 shows us that instructions are basically the line at a time information which you give to the computer, the directions you give to the computer, to do its job. They tell what things the computer is to do and what data it's to do it with. Let's look at that in a little more detail.

Figure 42 is a programer, working from a series of instructions to her about what problems to solve. She's created what we call a flow chart on the desk in front and this is the beginning of the programing process. She will be working in some language; some machine language, or assembler language, or compiler language, or problem language. These languages are ever-more complicated from the machine's point of view but ever simpler to use from the human's point of view, and we are attempting in our industry to approach the use of natural language as a programing tool. It may be many, many decades before that's successfully accomplished as we're a long ways from it at this point. Nevertheless, we have come a long way in terms of the capability to give instructions to computers in so-called higher level languages. Figure 43 shows this progression.

Let's look at what has to happen inside of a machine. We've got this arithmetic capability, shown in figure 44, that we talked about and this arithmetic capability can add, subtract, multiply, and divide, and there are some registers which hold the numbers that we want to deal with. Those registers may have been loaded from a memory location or they may be the memory location. In any event, we've got something in the computer as well as the data.

We have something called a stored program, as shown in figure 45, and that program is a set of instructions which look exactly like any other numbers in the computer. These numbers, however, have been very carefully prepared so that those instructions which appear like data will nevertheless cause the computer to fetch an item of data, add it to another item, and put it back in a different memory location. It is a sequence of very simple little steps like that that comprises the instructions given to a computer.

Figure 46 shows us three language levels. Almost no one uses the machine language level of programing anymore. That's the level at which the machine works, but everyone at least uses an assembler.

An assembler has the capability of telling the computer in fairly miserable detail what to do, but the programer can do it in a symbolic way and let the computer translate that symbolism into it's own instructions by means of a program called an assembler. A compiler is a higher level version of an assembler. You can be even less precise and somewhat more general about the kinds of statements. We'll look at that a little bit in detail later.

Figure 47 shows a programer writing a series of COBOL statements. COBOL is the common business language which has grown up in our industry and become rather a sophisticated tool for using computers.

Let's take a problem and look at it in the three different ways that it might appear, as shown in figure 48. Suppose we just want to add two numbers that are in storage and put them back. On the left you see the bit patterns as they might appear on the computer. The first line says to the computer, load the number at register 100,000, as you see at the far right. It doesn't tell it what that number is. It just says load that number into your register. And the next instruction says add to it the number at 101,000. And the third instruction says store the sum at 101,001. Those are the kind of bit patterns that would appear useful and important to a computer. The assembler language version of those would be the center column, as you see, and in a

compiler language, say, Fortran or COBOL, you would write just a single line. In COBOL, for example, you'd say, add X to Y, giving Z, and those X, Y, and Z addresses would be translated by the COBOL compiler to find those pieces of data automatically wherever they're stored in the computer, according to your preplan.

If one were to look at a single instruction word, as in figure 49, let's say a 24-bit instruction word of a certain kind of computer, you might find that the 9 left-most bits tell the machine what to do; say, add or multiply, or fetch a number.

The righthand 15 bits tell you which location to go to. Fifteen bits is enough to specify many thousands of address locations. It's not as powerful as 15 digits, remember; it's 15 bits; and a bit is just a yes or no, a 1 or a zero. But a combination of bits can give you a fairly large number.

We looked at those instructions and, in fact, I was reading this as 101,000 on the righthand end. It's really the decimal location 40, as shown in figure 50. That's the decimal number 40 when read from the binary system and so that particular instruction said load the register with the contents of that location. Figure 51 shows us that in an assembler it would be written down this way and this is the simplest level which man uses today. In a compiler, one would write a more general statement, as I described earlier and as shown in figure 52.

The programer turns in the instructions on punched cards or on written forms which get converted to punched cards by a key punch operator, gets back a run, which then consists of things the computer has done for the programer and a test of that program, and then she examines the results and perhaps makes some modifications. Figure 53 shows the programer examining the results of a run.

The programer has submitted the card deck to the computer center and gotten back the results as seen in figure 54. The computer operator at the center loaded the cards, as seen in figure 55, and the computer did a large amount of work to process that set of cards and give back that little output to the programer.

For example, the computer will exercise many hundreds of thousands of instructions in the fortran compiler, and it may do this millions of times just to compile a very simple program. The process is shown in figure 56. But that's the beauty and power of computers. They can do many simple things and they can do them incredibly fast and quite accurately.

We've talked about computer memory as being hierarchical and having quite a spread in cost and performance, but let's look inside of it a litttle bit and see what might be going on inside of the computer. There might be, say, three programs in the machine, illustrated in figure 57. The computer's memory is storing these programs and you might wish to alternately give control of the computer to one or another of these programs.

So the industry has invented what is called the operating system shown in figure 58. The operating system is capable of controlling which program is being run, which data is being fed to which program, and keeping all these pieces going simultaneously at a much higher rate than a man could do it sitting at a console and pushing buttons one after another. The operating system is quite a sophisticated concept, but it's basically again just the same simple extension of the

computer's capacity to do a lot of things, very simple steps but very, very rapidly.

The operating system has some goals, noted in figure 59. It provides some capabilities or else we wouldn't have them; but operating systems, in general, are not the purpose of computers. They are merely a thing to make the computer more useful to the ultimate user.

Figure 60 tells us that man controls himself and initiates control of the machines and indeed, man controls the machines in quite detail by the basic materials that he provides as a program. Without a program the machine is doing nothing. The machine is a very complicated computer consisting of tens of millions of parts and it is a useless collection of electronic junk without a program. That program was written by a man or a woman to provide the control of that machine so that the data that's fed into it is dealt with in the way the person who wants to use the computer intends it to be. The computer initiates none of that programing.

Figure 61 reminds us that man's nervous system is the mechanism that carries his signals around, but in the computer it's electronic circuits as noted in figure 62. There's really nothing very mysterious about them. They're very simple circuits like the circuit that you use to turn on the lights when you throw the switch. In the one case it's off; the other case it's on and by adding together the capability of many, many thousands, many millions of those little bitty pieces which are able to make those one or zero, on or off, yes or no kind of decisions you can build these things we call computers, which are the most complex devices known to man.

Man does his output through certain kinds of actions, shown in figure 63, which we understand; but computers do their output through screens, through printed listings, and on punched cards, as shown in figure 64. They may issue voltage signals which control the temperature. All sorts of output mechanisms exist for computers. We'll look at a few of them.

Figure 65 is a card punch. The cards are being stacked up, and inside they're punched in the same kind of a pattern as we saw for the punched cards on the input. Figure 66 is a printer with a typical kind of listing. Printers exist with the capability of making several copies, but this hard-copy mechanism is really rather slow compared to the tremendous speed of the inside of the computer.

This printer may print at 1,000 lines a minute. There have been printers made that print 30,000 lines a minute, and you say, my goodness, how can anybody read that? But then when you think about printing the label, say, for mailing a magazine, you might want to print 5 million address labels and it's read by 50,000 postal delivery men in parallel, and so printing them at 30,000 lines a minute is not really very fast, if you want to print lots of them and get them distributed to all the people who are going to read them simultaneously.

Tape units are used for output, as seen in figure 67. We've talked about tape units before, but many of the results of the run of a computer are recorded on tape, then taken away to an archive and stored with the tape containing the results. Again, they're only useful as input to another computer run or to a machine which can read that tape.

A goodly number of institutions are now making use of computer graphics, as it's called. The display shown in figure 68 has on it a graphical picture of an architectural drawing or a design of a piece of machinery. A number of automotive companies are beginning to use this technique.

Executives are beginning to get the capability of computer at their fingertips, although some of the science fiction literature you read about it would make it seem as though the electronic revolution is here. It's not really here yet. It'll be a while. If it's used properly, with the proper digestion of data, the management information system can be tremendously powerful. It's mostly been abused rather than correctly used. Some executives and even some sales offices, for example, have teletype connections to computers. Brokerage houses have them. Examples are shown in figures 69 and 70.

The computer sometimes controls other machines, as noted in figure 71. For example, a milling machine or the trajectory of a ballistic missile.

A computer in the ground somewhere may be controlling the ballistic missile shown in figure 72, or it may be a computer in the missile itself. It may be in the submarine which launched the missile, or the location of the submarine may itself be being computed by a computer, as shown in figure 73.

The control of refineries, shown in figure 74, has become such an esoteric art and it's so important to get that extra 1 percent of yield out of millions of barrels of product going through that it's becoming imperative to control refineries with computers because they can do that control so much more precisely, so much more rapidly than people.

Computers are heavily in use in at least one automobile plant, the Volkswagen plant in Germany, shown in figure 75, where many thousands of tests are made on the vehicles as they're being assembled. Those measurements are continuously fed into and monitored by a computer. The inspection record for every vehicle is then known at the end of the assembly line.

Traffic is being controlled by computers, shown in figure 76. There are installations in a number of cities. Minneapolis has an installation which monitors the traffic and meters the cars onto the freeway, depending on the flow. Los Angeles has a system that even flashes warning lights, and overhead signals to people.

Figure 77 reminds us that one of the things that computers cannot do: They cannot do any initiative reasoning, make any judgments, or do any thinking to any degree of profundity. The anthropromorphic aspects of computers have been highly overrated by the fiction writers, and while computers can seem quite awesome and quite miraculous in the things they do, they're really doing very simple things that they have been instructed to do by people. A computer can't act on judgment. It can't philosophize; it can't do any of the kinds of things that people do. They can't set policy. Figure 78 lists these points.

A computer can't react like a man in the reasoning, thinking area. It can only do the five things that man can do, as shown in figure 79, so it's natural to ask the question, what makes a computer so great—and the answer is quite simple.

Figure 80 tells us that a computer has the advantage over people in speed, accuracy, capacity, and reliability. Now, it may not seem

to you, when you get a glitch on your department store bill, that the computer has been very accurate or very reliable, but as a matter of fact it was precisely accurate but it was given the wrong inputs by some people or it was given the wrong program by some people, and as a consequence it went ahead and did what it was told to do and it produced an erroneous bill. That doesn't mean the computer made a mistake. It means that the people providing the input or writing the program made a mistake. Almost never does the computer make a mistake—almost never. In fact, with the complexity of modern operating systems, and the complexity of the modern programs which are written for computers, the thing comes to a screeching halt if anything goes wrong.

If a part fails inside the machine, it's doing so many millions of operations per second that it immediately comes to a stop. It just doesn't know what to do. It immediately goes out of business. So in the unlikely event of a computer piece of equipment failure, which is relatively rare, relatively compared to the millions of things that it does do correctly, the computer's occasional apparent mistake is not real. It's a mistake caused by erroneous input by people or an erroneous program that was written or erroneous data that was fed to the machine.

So a computer has these advantages over people. It has the speed, for example, to do problems which are unthinkable—which were unthinkable a few decades ago—and the number of those problems which are opening up to being solvable by computers is getting larger all the time. The speed of computers has made possible things like nuclear energy or doing guidance of a trajectory of a shell while it's in flight; things that are just unthinkably too fast for people to do any calculations about. The computer can do calculations while the event is happening.

Mr. Chumbris. I guess if a computer throws out a $1 million check, it's a person that did it and not the machine?

Mr. Parkin. Almost without exception it's the operator who did it, or the data that was prepared wrong; not the computer.

Most of the flight tickets that you buy these days are prepared and kept track of by computers, as shown in figure 81. Almost every place you go to to reserve a flight would need whole rooms full of girls answering telephones and trying to keep track of flight reservations. Can you imagine a room the size of this whole office building? That's what it would take to keep track of the reservations for two or three of the major airlines in this country today, if it weren't for computers.

A number of the aircraft companies, United, among others, are using computers in their maintenance scheduling, as shown in figure 82.

They keep track of exactly which component on which plane has flown how many hours and when it's scheduled for preventive main-

tenance and when it's scheduled for overhaul. In fact, they worked out the scheduling of which airplane goes on which route so that it ends up back at the overhaul shop in Denver at the right time; and if they didn't do this they might get much less utilization out of their airplanes by scheduling them with people than by computer.

Figure 83 reminds us that Amtrack is giving its tickets and reservations by computer. That whole system is a little creaky yet, but it'll get there.

In the whole oil exploration business one of the things which is done is the so-called seismic exploration. A crew will go out in the field and they'll plant a half a dozen sticks of dynamite around in a circle, maybe 5 miles in diameter, and they'll set them all off at once and the pattern of the little echo waves that come reflecting back from the underground locations as recorded by a seismograph instrument like the pattern shown in figure 84. These little patterns in the past used to be looked at by some human. Figure 85 shows what he was looking at, miles and miles of paper with those little squiggles on it. It took a very rare genius to understand those patterns. But with computers those data can be digitized and analyzed by computers and they can find some major oil finds that would never have been suspected before by that technique. Every oil company is using it extensively.

In banking you'll find teleterminals at your friendly neighborhood bank, spreading throughout the country quite rapidly, as shown in figure 86. It's not universal yet but almost all banking will be done, almost all banking internally is done, on computers today. Externally it will become available to people as customers and even the transfer of funds between cities and between banks will be done by computers.

A large amount of educational potentiality exists in the computer business where computers can be used for providing instant feedback to the student, as shown in figure 87, and can be used for providing a much more graphic display, and can go at the pace of the learner rather than at the pace of the teacher.

I bring back these pictures of a system, figures 88 and 89, to summarize briefly where we are. A computer is a remarkable versatile machine which can serve the interests of mankind in a wide variety of ways. Figures 90, 91, and 92 tell us that computers are very sophisticated electronic devices, but remember they handle numbers and they handle numbers only that people have given them; and they handle them in a way that people have instructed them to handle them. Computers work extremely rapidly. Very much under the control of the people who program them and operate them, although operating systems are tending to take over the routine functions of the operator. The operating system doesn't take over the responsibility of providing a particular application to a particular computer. That's still done by people.

Essentially, the thing you can say about computers is that they're used mostly where large amounts of information must be processed

quickly and when the processing can be described in an exceedingly simple series of steps which can be very complicated, very long, and are highly repetitious by virtue of the computer operating on its own instructions; but they must be all thought through in advance by people. These are the conditions under which computers are the most valuable.

If we can have the lights now, I will show you some sample parts and give you some feeling about the insides of the machines.

Some of the things I'd like to say about the future will come after I show you a few of these pieces now. Take the whole package up.

These are the kinds of things in the early 1960's, late 1950's, there were about three circuits in that. You had thousands of them, and you plugged them in big boxes.

That's what made up the contents of those boxes. That's one transister. You know the size of a pea. It's a good sized piece of hardware.

That little thing inside there is the transistor, and a few years later we began putting them in little packages like this, and there are maybe 30 to 40 circuits in this package.

This is probably a better example of it with them lined up in a row like that. Then a few years after that, late 1960's, early 1970's, we began producing them like this, with maybe 300 of them in there.

You can just barely see the transistor, little hints of material inside the box, and there may be 300 or 400 in that box.

The prices kept going up for the box but down for the average element. This cost $10. This cost $200 when it was first built. They're now about $25.

This cost $1,000 when it was first built. They are now down to about $200, but an individual transistor went from $3 to $5 in this array, down to $1 in this array, or maybe 50 cents; so the individual packages cost more but the aggregate costs less per item.

Now, in the latest technology these are what are called integrated circuits. Underneath that little plastic chip there are 30, 40, or 50 circuits equivalent to this box. In that little plastic package, in fact, most of the active part is in the little space of about one-eighth of an inch square inside that plastic package.

Computers are now being built out of these things where the wiring is printed mostly on these boards inside. For example, that is a whole computer.

In Von Neumann's day, that was unthinkable. The computer was the size of this whole desk up here. Memories are shrinking. This is an example of a memory board in today's integrated circuited memory technology.

Chips on this side contain the individual bits of memory, but there may be 1,000 of them in there or 4,000. It's beginning to become standard to have 4,000 bits in that little chip.

Senator HART. And the cost?

Mr. PARKIN. The cost is going down per bit, but it still costs you a lot to put this all together.

Here are some cores. Just to show you what they look like. It looks like dust. Each one of those has a little hole in it.

It's unbelievable what they do. You have to have a magnifying glass to see it.

Senator HART. No. I can see it.

Mr. PARKIN. There are some various sizes and some samples. They put three wires through those.

Senator HART. The tiniest has a hole in it?

Mr. PARKIN. Yes. And you put three wires in that hole.

Mr. LORETTE. This is done by human manufacturers.

Mr. PARKIN. We don't have machines to do that yet. Mostly people in Hong Kong, Korea, or such places do this.

Senator HART. Is any of it done in this country?

Mr. PARKIN. A good deal of it is done here.

These can be inserted in the board with a tool, and the whole board is soldered by dipping in a bucket of molten solder by a machine.

This can all be assembled by a machine, and it makes the cost of memory come down very drastically compared to stringing those on wire.

It's not down yet far enough to compete totally with cores today, but it will be down cheaper. It keeps getting cheaper all the time.

Let me make a few more remarks about that.

There are two very forceful trends in our industry. In the one case, hardware is getting smaller and less expensive all the time, and it seems to be doing so on a steady curve. It just does not stop being less expensive. If the cost of a certain kind of technology bottoms out. then a new technology evolves which drives the cost down still further. And that seems to be a continuing trend to which none of us can see any stop, any end in sight. In fact, if you extrapolate it, it becomes clear that at some point, with the cost of the hardware coming down continuously and the cost of people continuing to rise, which is the other horn of our dilemma, and it is the software which is done by the people, the programing, the preparation of data, the handling of instructions which is causing the cost of computer systems to go up, it is clear that at some point the computer will be the giveaway item, and the programing will be what you charge for. In the past, it used to be quite different. You charged for the hardware and gave away the programing. In my estimation, the continuing expansion of the use of computers is basically economically limited today. That is to say that computers are such a capital-intensive item, from the point of view of the consumer of the computer; that is, the industry that wants to use a machine or the Government agency that wants to use a machine.

It is an expensive proposition. The user pays $1 million, or $2 million, or $5 million for a big computer, and he pays $1 million, or $5 million, or $20 million, or $50 million for the programing to go around that machine.

Those are big numbers which must be thought through very carefully in making an investment. So in a sense, a computer is not an ongoing expense like a desk calculator might be, or like a telephone.

A computer is a capital expense at the time you install it for the job it is going to do, as well as an ongoing expense for the operation of it.

Thus, the spread of computers is limited by its competition for the demands of other capital; capital for a rolling mill is in competition with capital for a computer to control that rolling mill in the same company that is going to be building it. So the computer becomes a major factor in the capital-intensive world, so that its spread is really basically limited by the availability of capital.

But the spread of its usefulness, the things that computers can do, are so enormous, the capabilities are so vast that there is no end in sight to the number of kinds of things that computers will do and can do for people.

It is purely a question of can we afford the programing for those installations, because with the cost of the hardware continuing to go down, pretty soon it will be so inexpensive that the whole application of computers will be strictly limited by the availability of people.

Indeed, it really is nearly that way today, but people don't quite realize it. It is the lack of availability of trained manpower to do programing and to do applications for computers that is limiting their spread and their applicability to things of benefit to mankind.

I am prepared to answer as many questions as you would like to ask. I could talk from 5 minutes to 5 days, or 5 years, on computers.

I have been deeply steeped in the technology of computers for so long that I'm really prepared to talk about it.

Senator HART. Well, if I were a computer I would probably have a lot of questions to ask. I am a little more comfortable after listening to the explanation and seeing the pictures.

I realize now I should have long ago taken up the invitation, to go to a place where computers are assembled.

Mr. PARKIN. You are more than welcome to come to Control Data Corp. We would be pleased to have you and tour you through any facility. It would be interesting to you or any member of your subcommittee.

Mr. NASH. I have no questions, thank you.

Senator HART. Mr. Chumbris?

Mr. CHUMBRIS. I have no questions either, thank you.

I read with interest and listened with interest to the charts you have presented. Fortunately for me, Mr. Jerry Hellerman, Mr. Dave Martin, and I went to some plants and watched them put some computers together.

Still, there is much one can learn about computers. We very much appreciate the testimony you have given us this morning.

Mr. PARKIN. Thank you very much.

Senator HART. Mr. Lerette, did you have anything you wanted to add?

Mr. LORETTE. No; thank you.

Senator HART. Well, again, thank you both.

[The following was received for the record.]

MATERIAL RELATING TO THE TESTIMONY OF THOMAS R. PARKIN

Exhibit 1.—*Figures and charts mentioned throughout the testimony of Mr. Parkin*

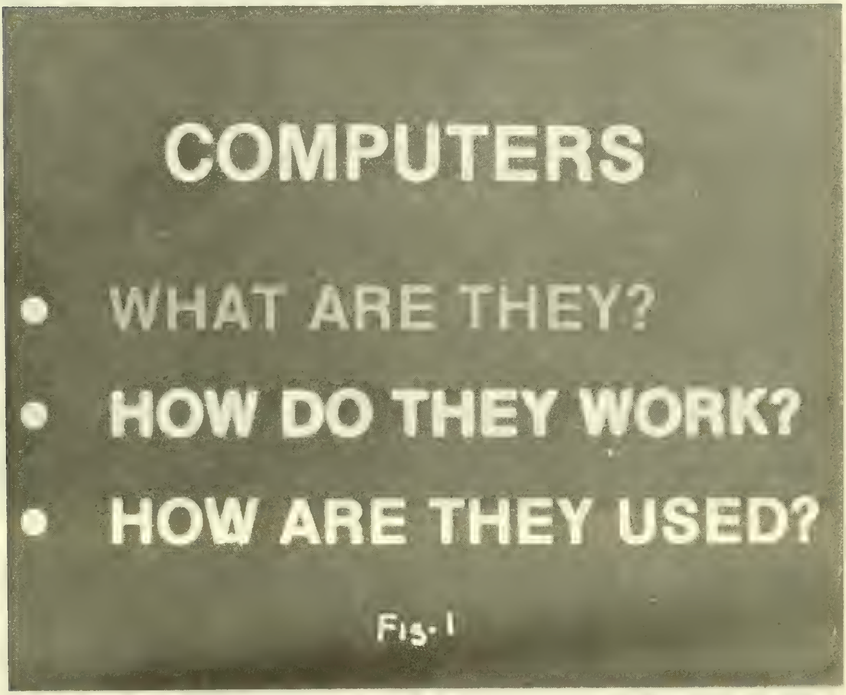


Fig. 1

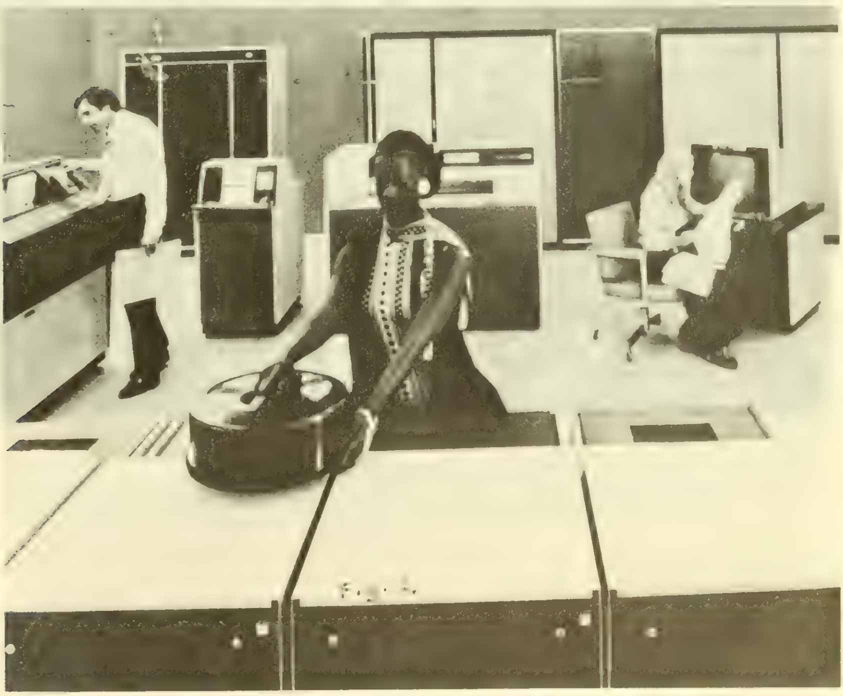


Fig. 2

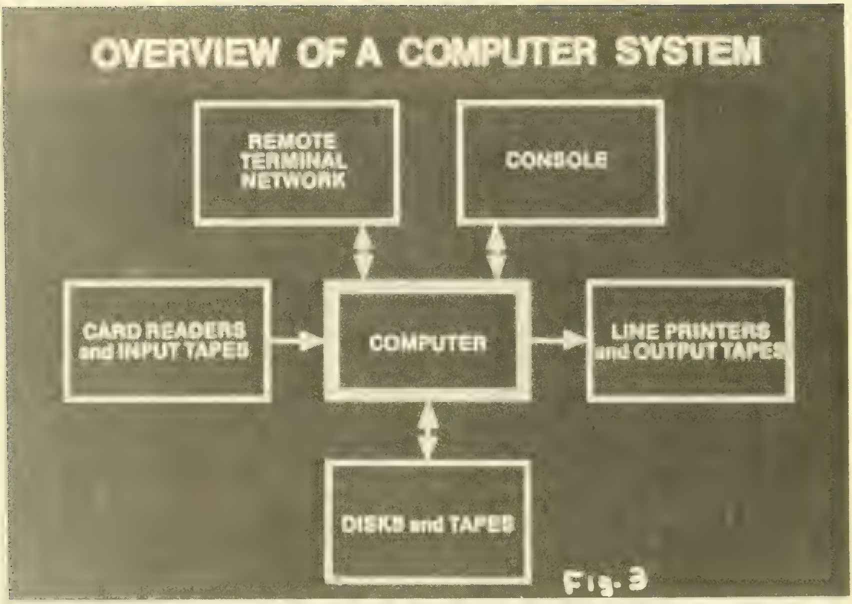

OVERVIEW OF A COMPUTER SYSTEM
REMOTE TERMINAL NETWORK
CONSOLE
CARD READERS and INPUT TAPES
COMPUTER
LINE PRINTERS and OUTPUT TAPES
DISKS and TAPES

Fig. 3

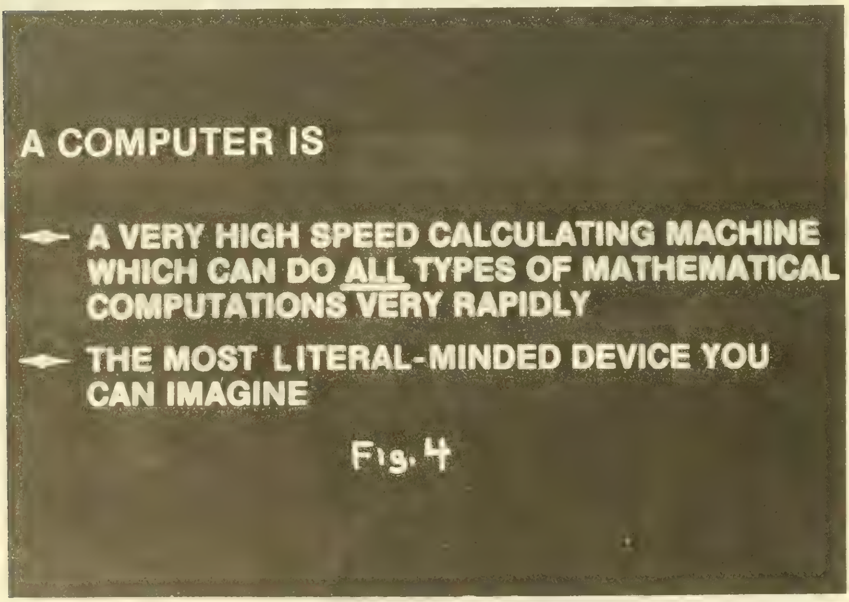
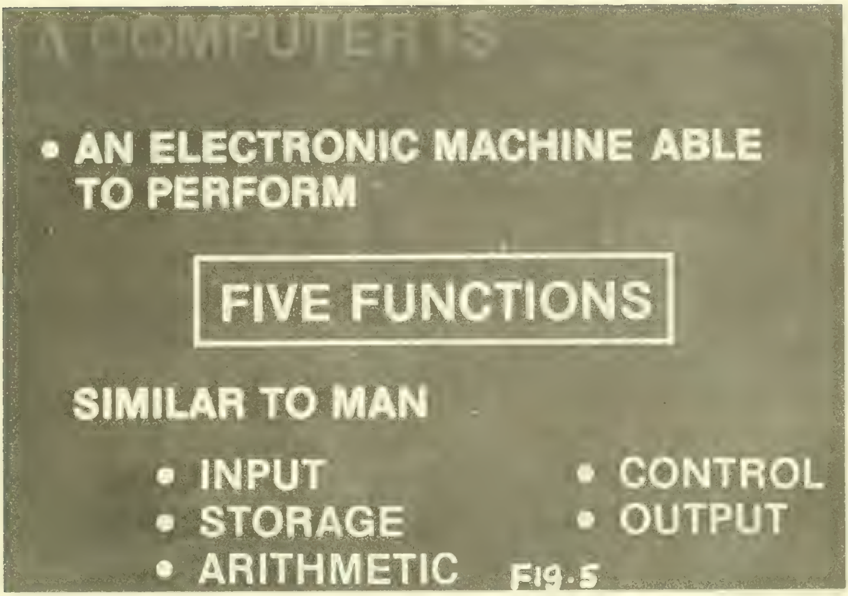

A COMPUTER IS
A VERY HIGH SPEED CALCULATING MACHINE WHICH CAN DO ALL TYPES OF MATHEMATICAL COMPUTATIONS VERY RAPIDLY
THE MOST LITERAL-MINDED DEVICE YOU CAN IMAGINE

Fig. 4


A COMPUTER IS
• AN ELECTRONIC MACHINE ABLE TO PERFORM
FIVE FUNCTIONS
SIMILAR TO MAN
• INPUT
• STORAGE
• ARITHMETIC
• CONTROL
• OUTPUT
Fig. 5


CONTROL
STORAGE (MEMORY)
INPUT
ARITHMETIC
Fig. 6

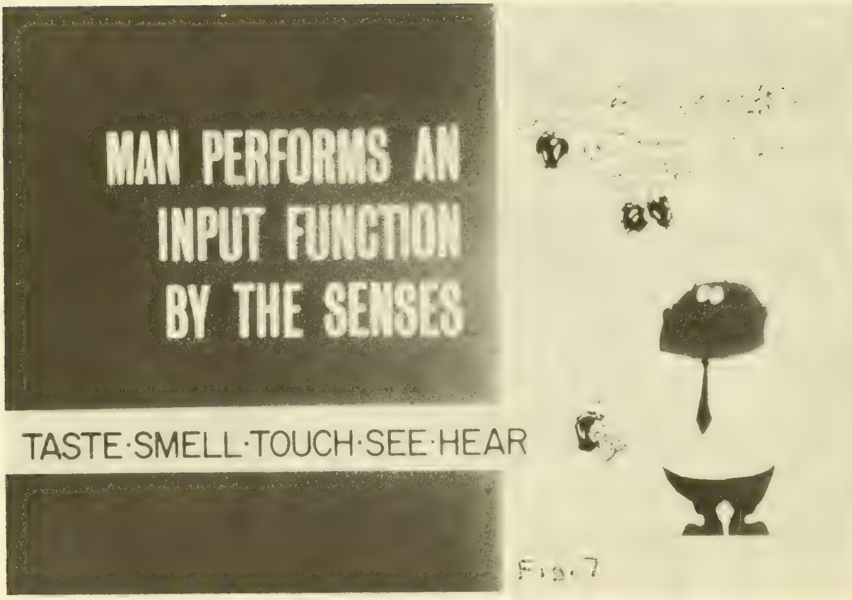
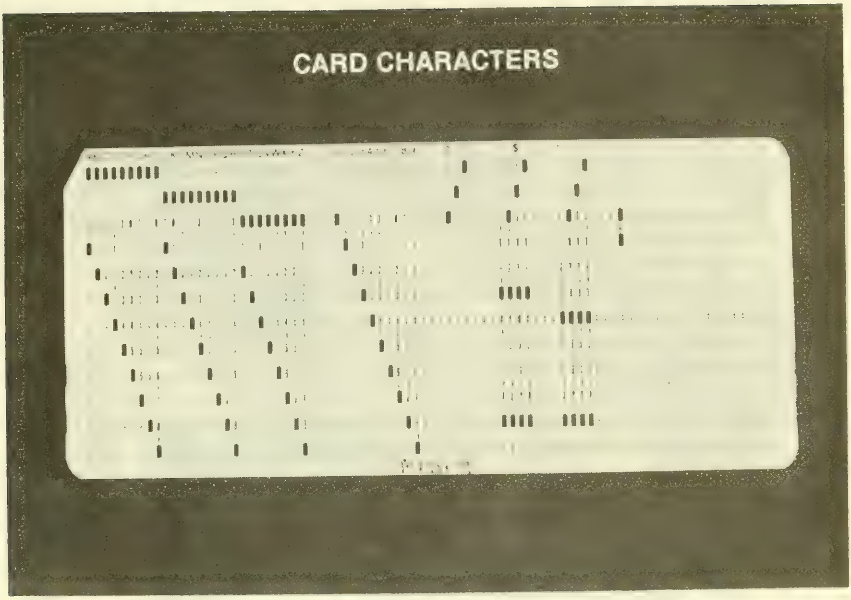
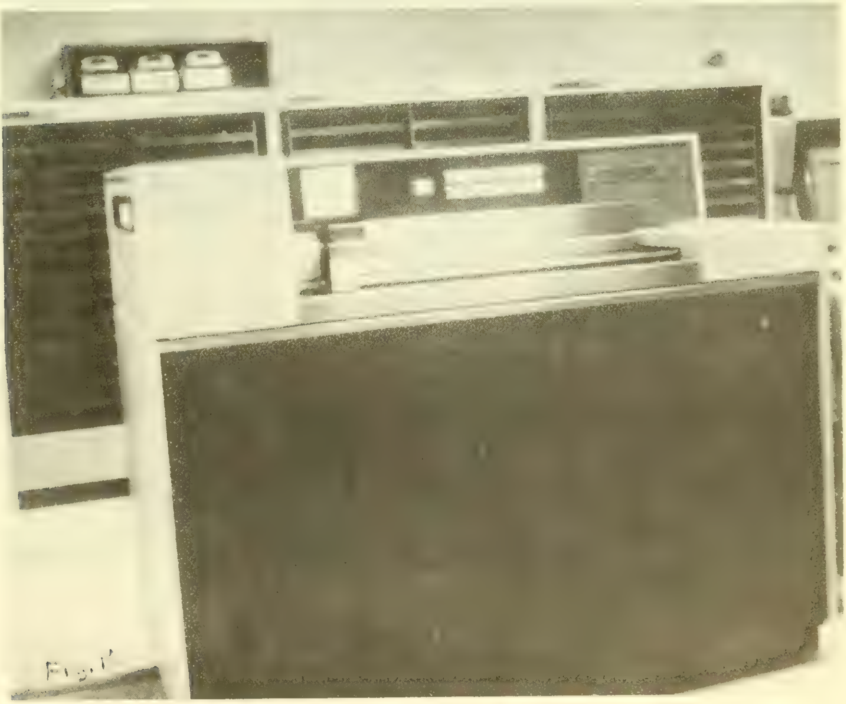

MAN PERFORMS AN
INPUT FUNCTION
BY THE SENSES
TASTE·SMELL·TOUCH·SEE·HEAR

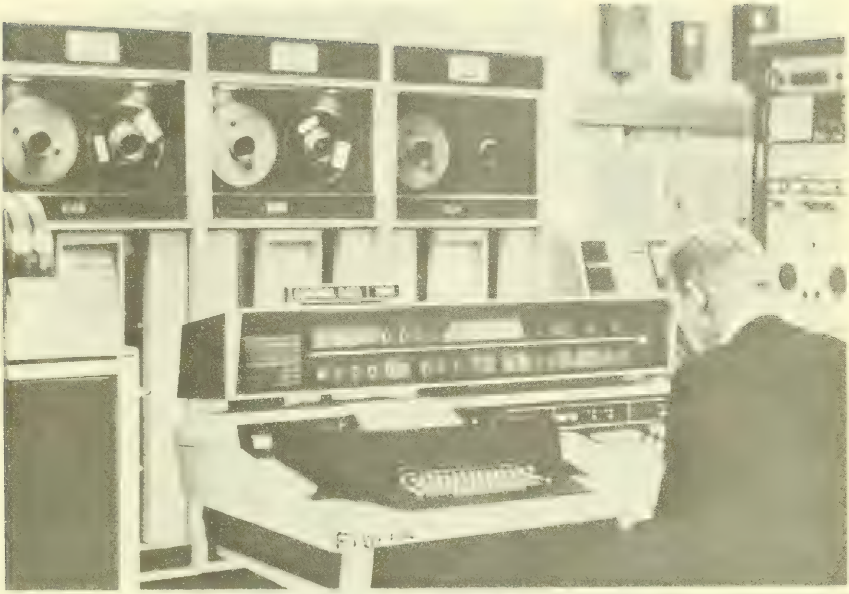
Fig. 7


COMPUTERS
PERFORM
INPUT
BY
PUNCHED CARDS PUSH
MAGNETIC TAPE
PUNCHED PAPER

Fig. 8


CARD CHARACTERS





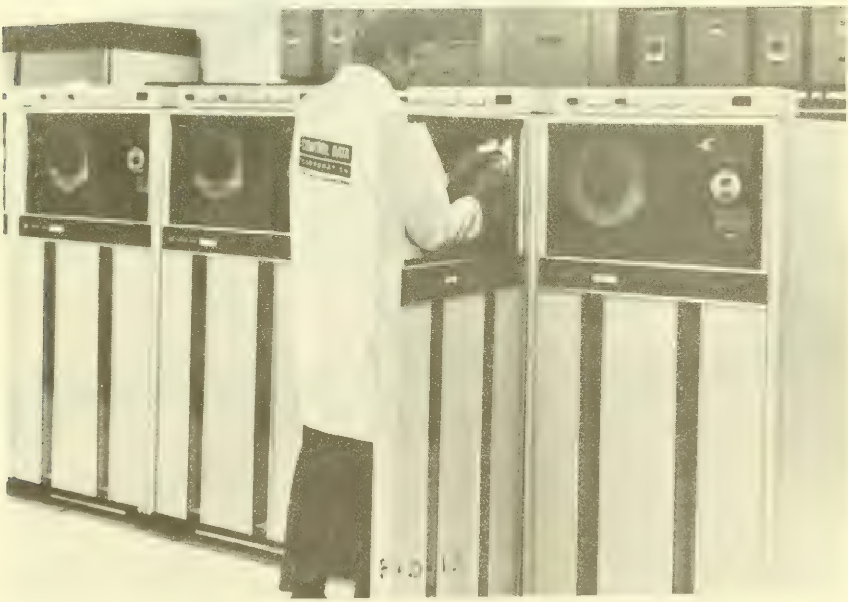


Fig. 14

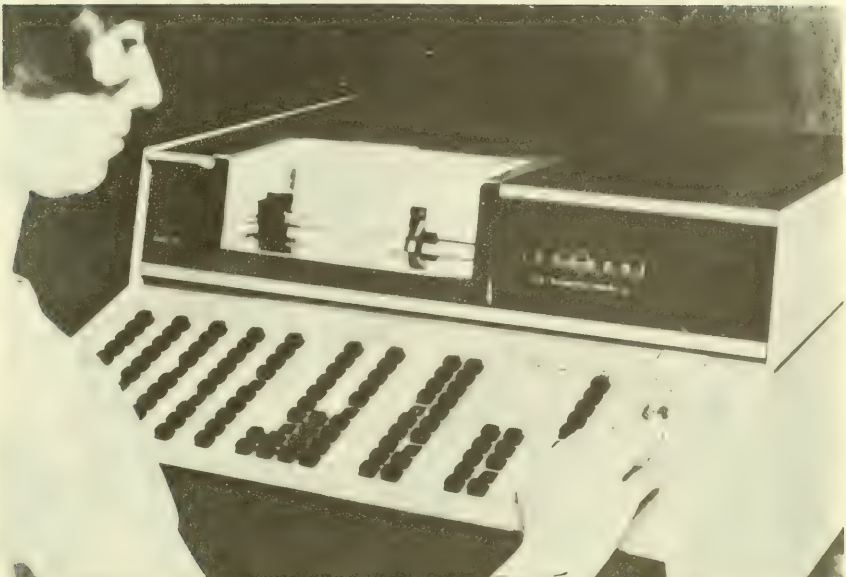


Fig. 15

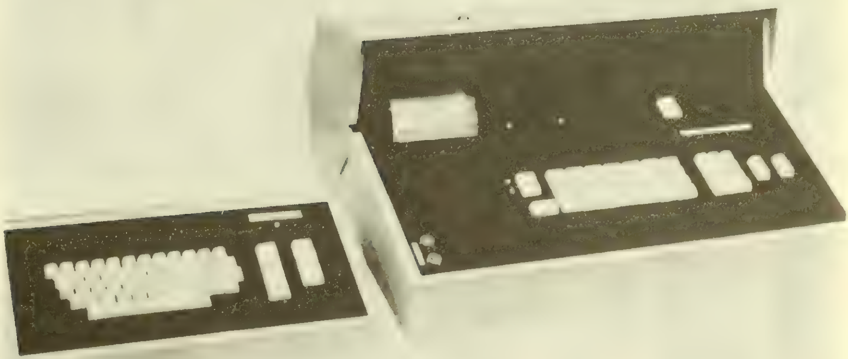


Fig. 16

Fig. 17

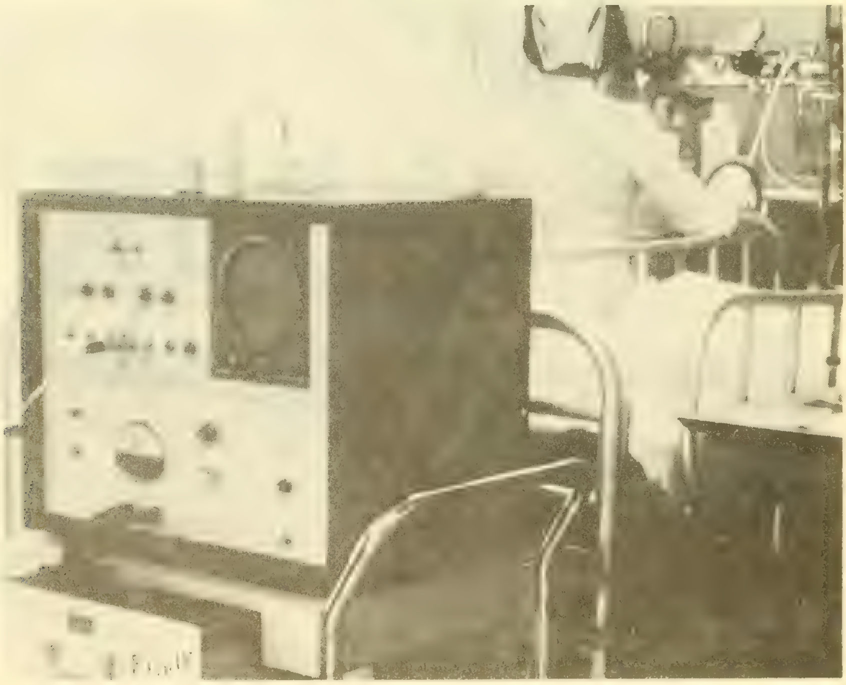


Fig. 19

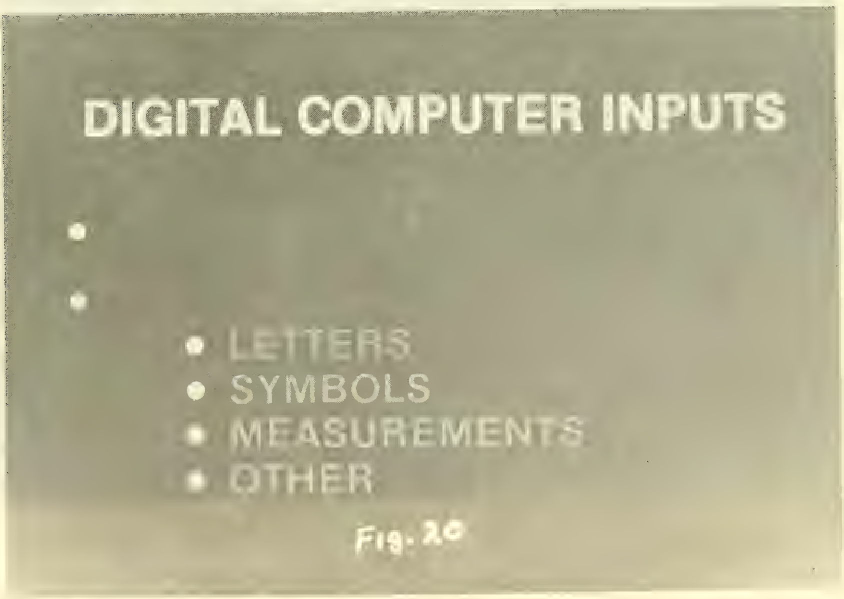


Fig. 20

40-027 O - p[illegible] 7 - [illegible]


Man performs a
storage function
by memorizing
and recording

Fig. 21


a Computer
performs storage
by
ELECTRICAL CIRCUITS
MAGNETIC DRUMS
MAGNETIC CORES
MAGNETIC TAPES
PAPER TAPE
PUNCHED CARDS

Fig. 22

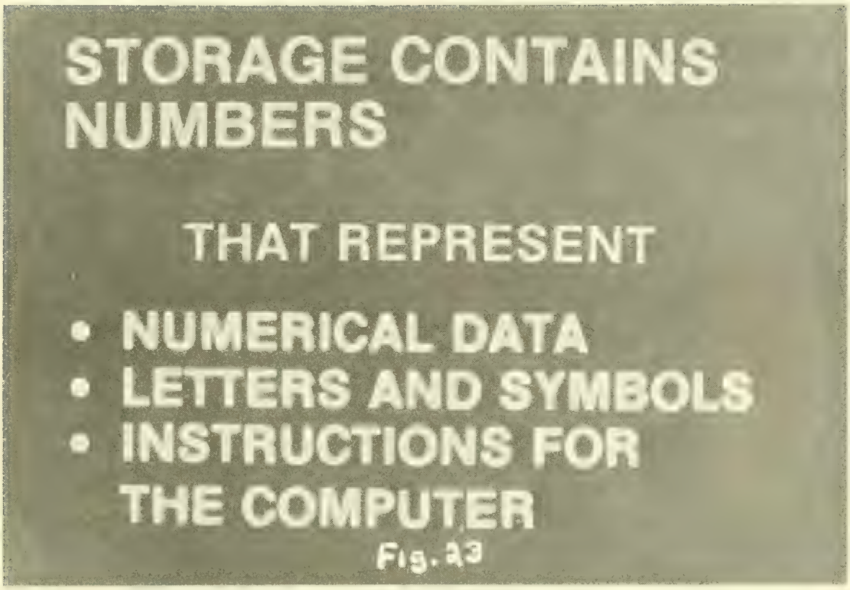
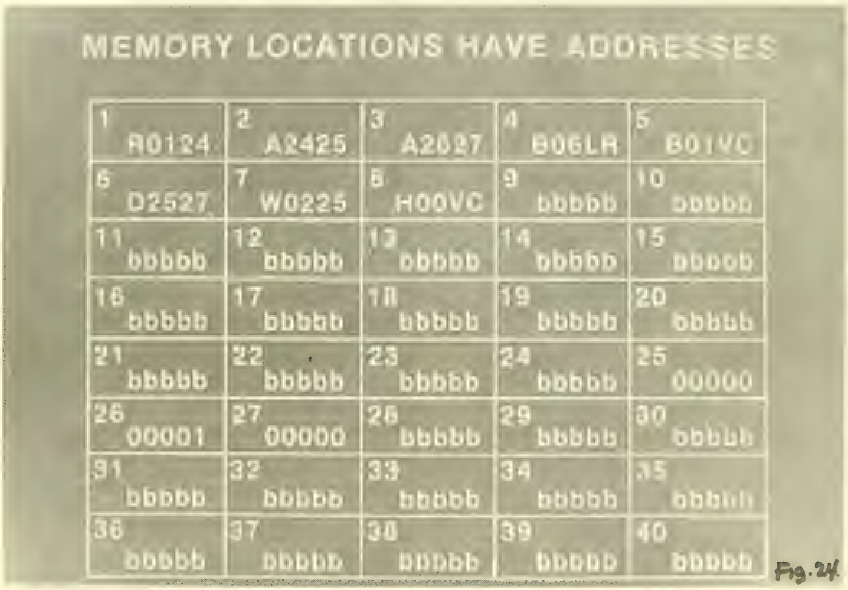
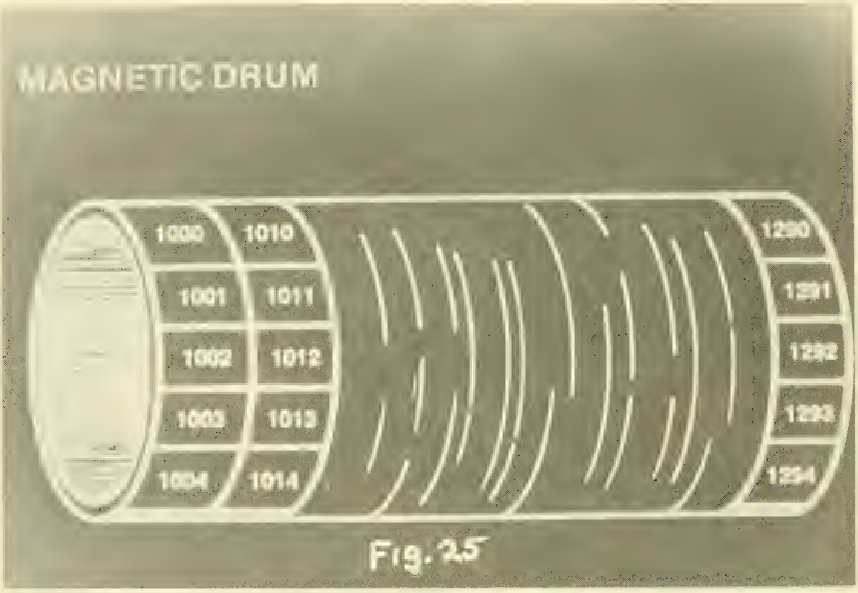


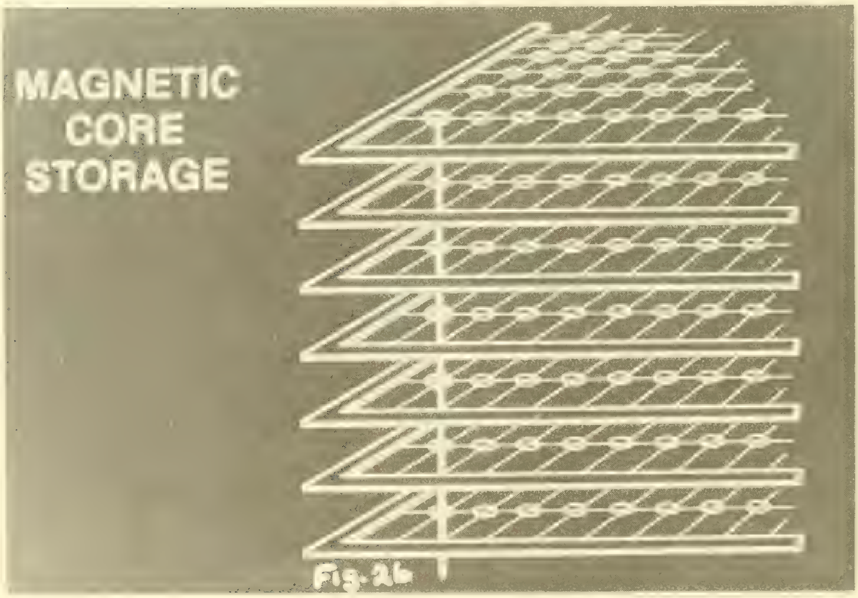
Fig. 23

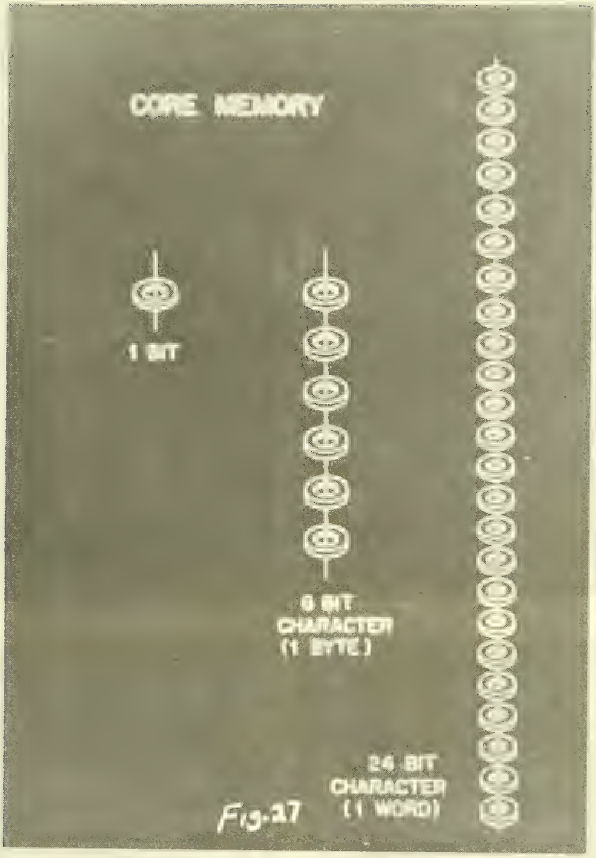


1 R0124	2 A2425	3 A2627	4 B06LR	5 B01VC
6 D2527	7 W0225	8 H00VC	9 bbbbb	10 bbbbb
11 bbbbb	12 bbbbb	13 bbbbb	14 bbbbb	15 bbbbb
16 bbbbb	17 bbbbb	18 bbbbb	19 bbbbb	20 bbbbb
21 bbbbb	22 bbbbb	23 bbbbb	24 bbbbb	25 00000
26 00001	27 00000	28 bbbbb	29 bbbbb	30 bbbbb
31 bbbbb	32 bbbbb	33 bbbbb	34 bbbbb	35 bbbbb
36 bbbbb	37 bbbbb	38 bbbbb	39 bbbbb	40 bbbbb

Fig. 24.


MAGNETIC DRUM
1000
1001
1002
1003
1004
1010
1011
1012
1013
1014
1290
1291
1292
1293
1294
Fig. 25


MAGNETIC
CORE
STORAGE
Fig. 26


CORE MEMORY
1 BIT
6 BIT
CHARACTER
(1 BYTE)
24 BIT
CHARACTER
(1 WORD)
Fig. 27

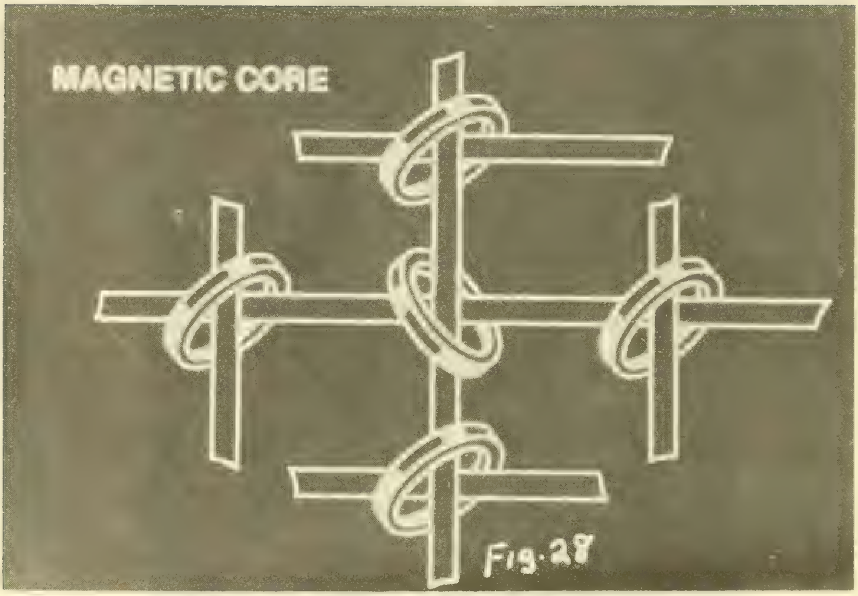


Fig. 28

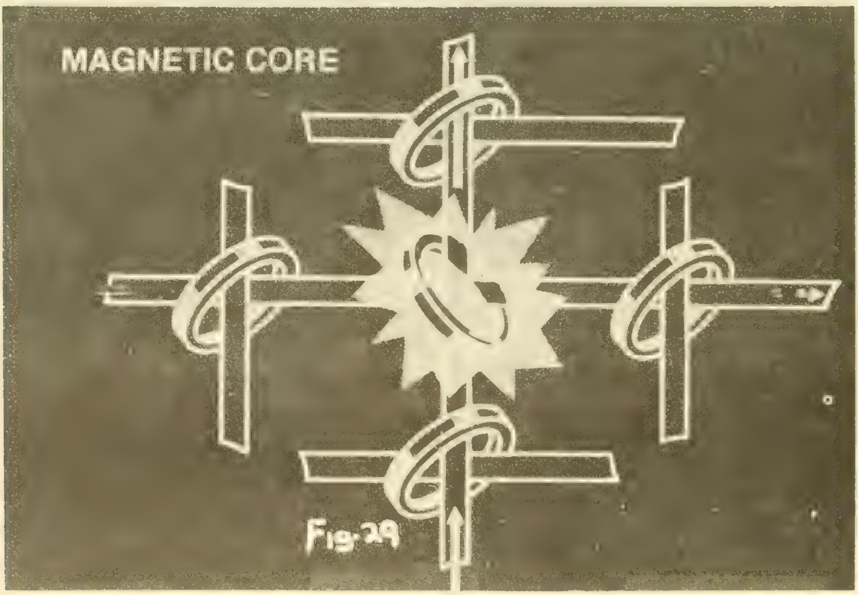


Fig. 29

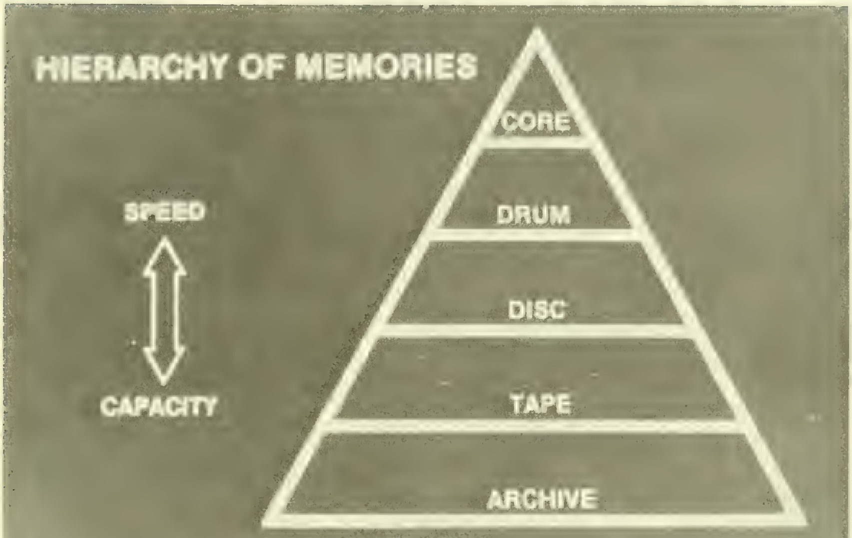

HIERARCHY OF MEMORIES
SPEED
CAPACITY
CORE
DRUM
DISC
TAPE
ARCHIVE

Fig. 30

Fig. 31

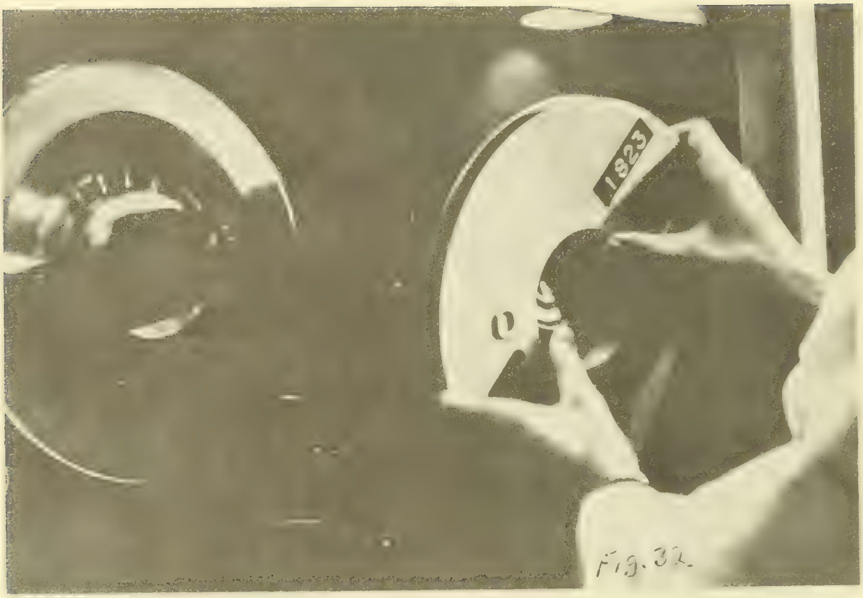


Fig. 32

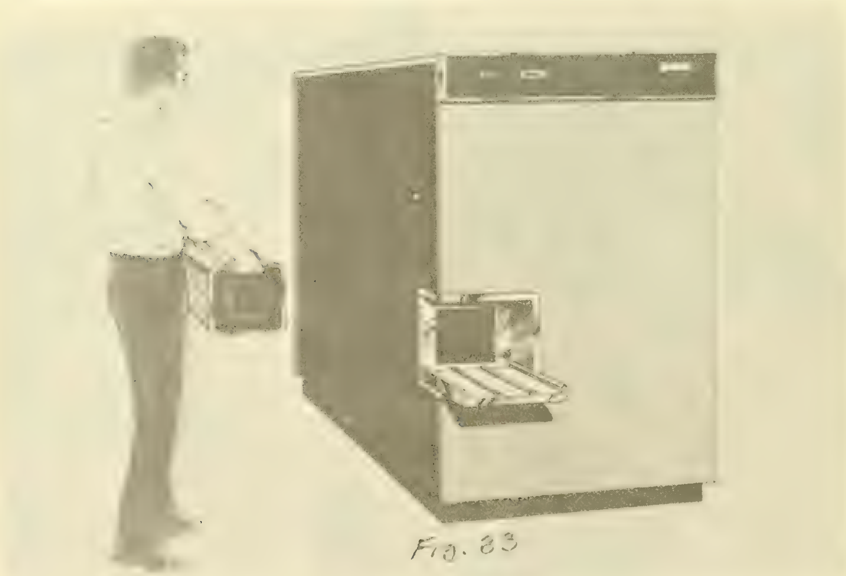


Fig. 33

STORAGE HIERARCHY

MEDIA	ACCESS TIME	COST-BIT
MAIN MEMORY	.000001	.20
EXTENDED	.00001	.02
DRUM	.001	.002
DISK	.01	.0002
TAPE	10.	.00002
CARDS	100.	.000002

Fig. 34

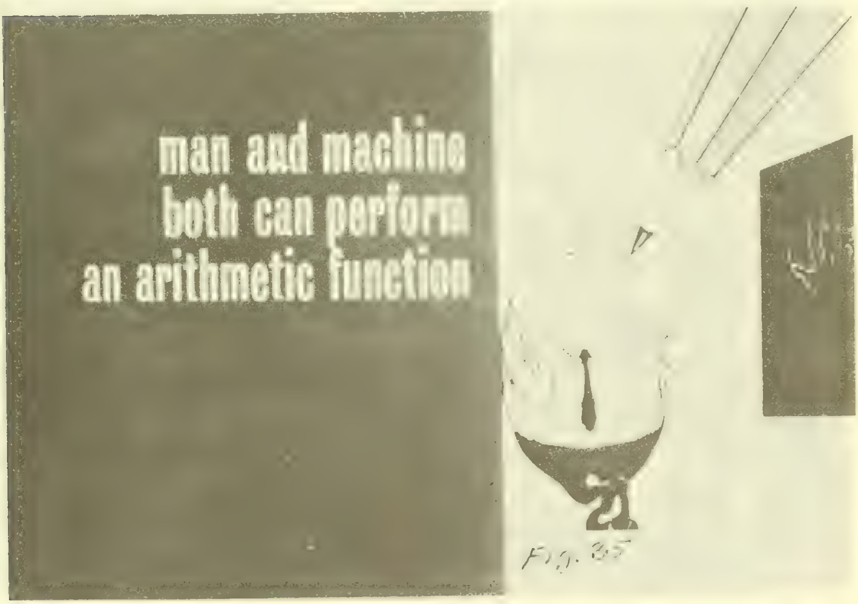


Fig. 35

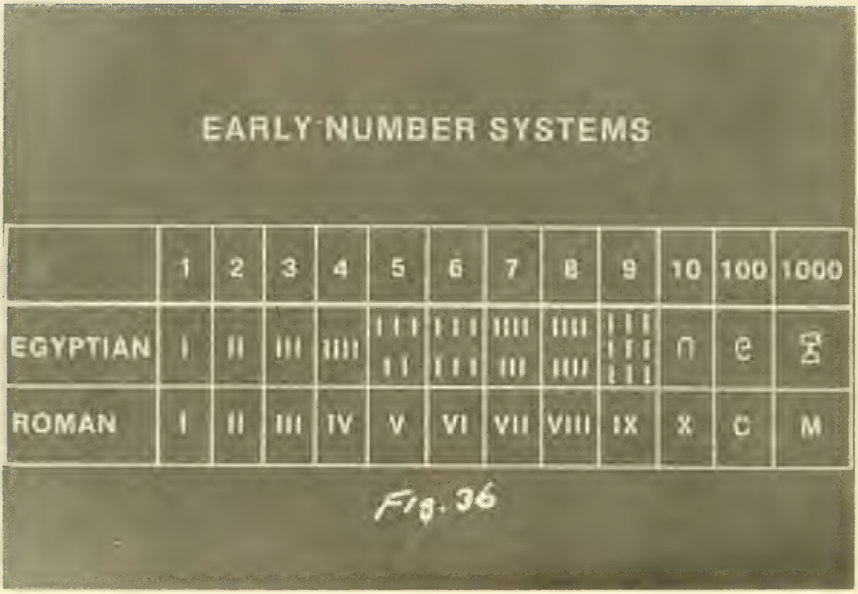

EARLY NUMBER SYSTEMS
1 2 3 4 5 6 7 8 9 10 100 1000
EGYPTIAN
ROMAN I II III IV V VI VII VIII IX X C M

Fig. 36

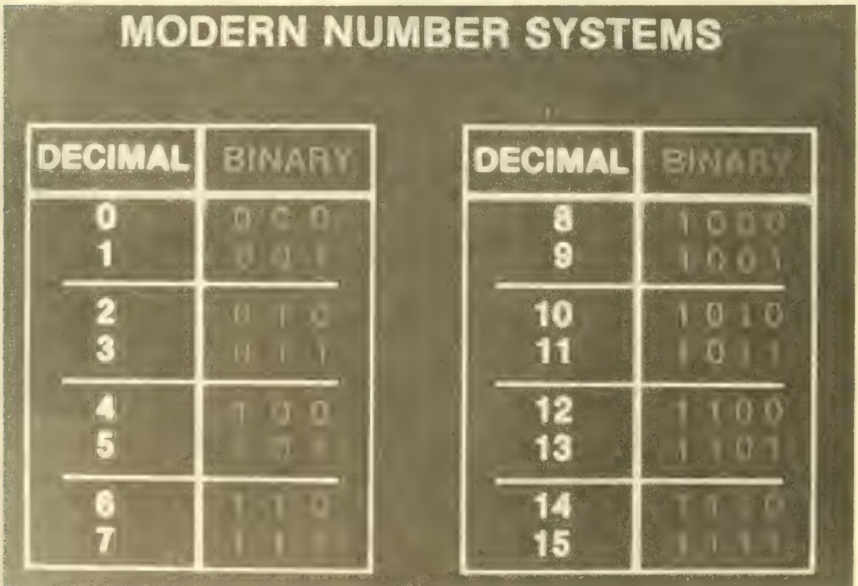

MODERN NUMBER SYSTEMS
DECIMAL BINARY
0 000
1 001
2 010
3 011
4 100
5 101
6 110
7 111
DECIMAL BINARY
8 1000
9 1001
10 1010
11 1011
12 1100
13 1101
14 1110
15 1111

Fig. 37

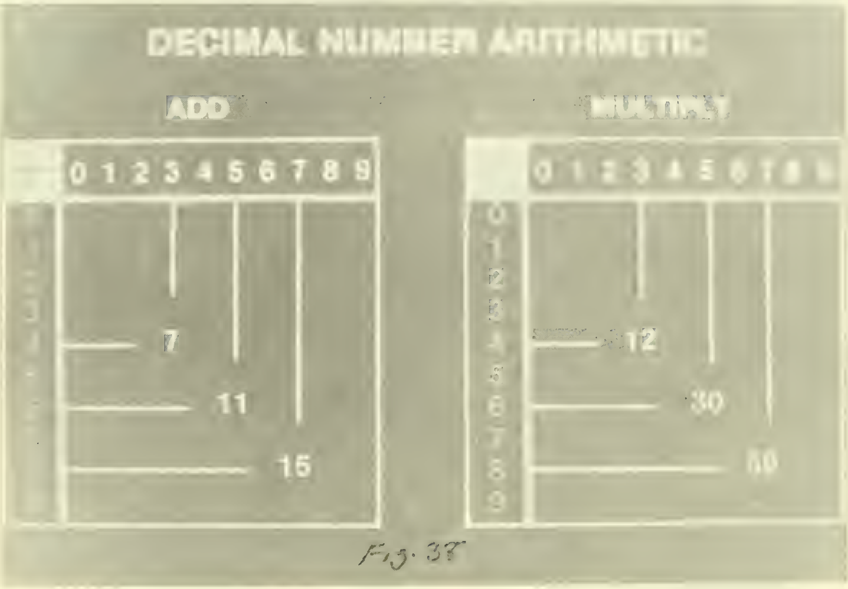

DECIMAL NUMBER ARITHMETIC
ADD
MULTIPLY
0 1 2 3 4 5 6 7 8 9
7
11
15
12
30

Fig. 38

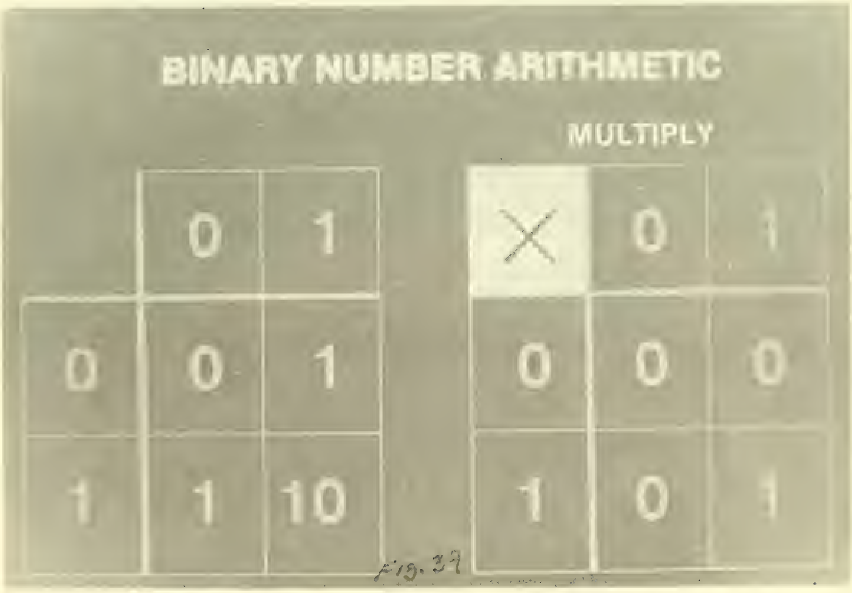

BINARY NUMBER ARITHMETIC
MULTIPLY
0 1
0 0 1
1 1 10
× 0 1
0 0 0
1 0 1

Fig. 39

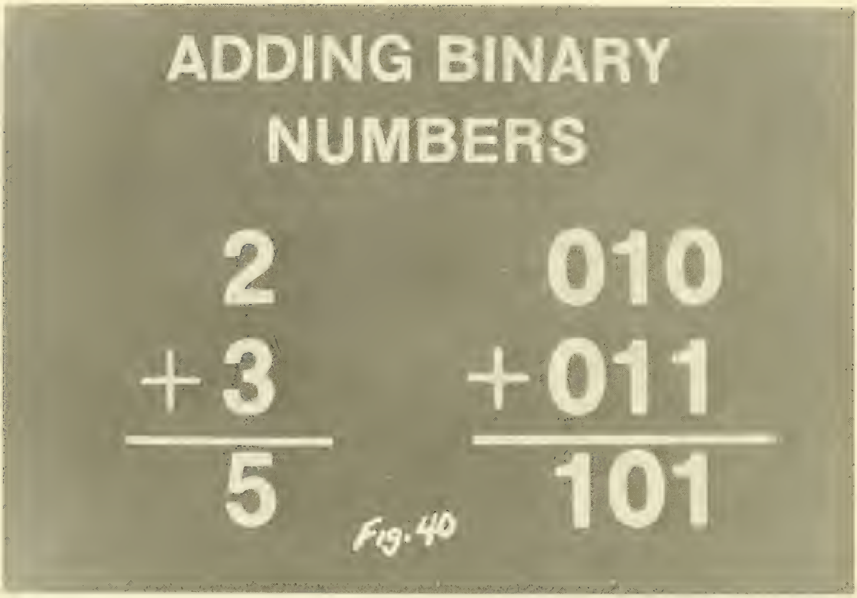

ADDING BINARY
NUMBERS
2
+3
5
010
+011
101

Fig. 40

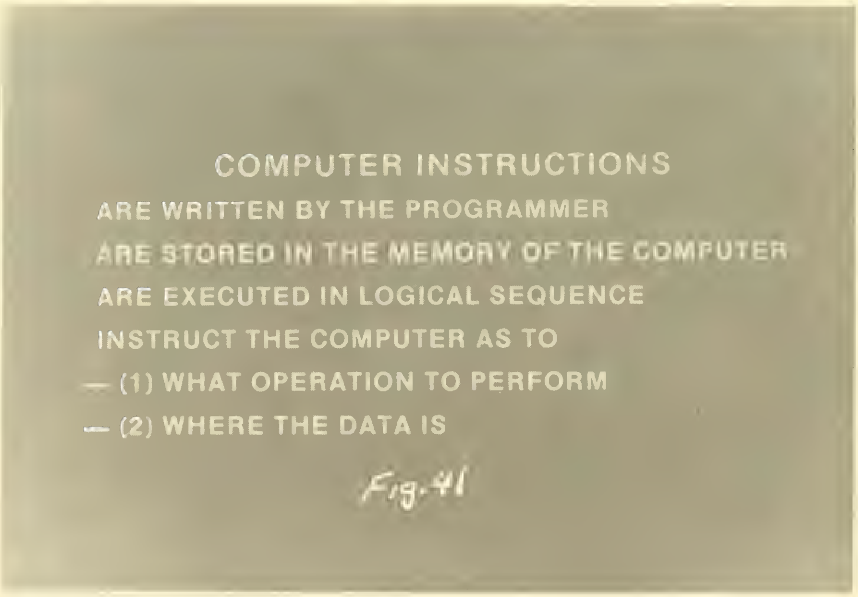

COMPUTER INSTRUCTIONS
ARE WRITTEN BY THE PROGRAMMER
ARE STORED IN THE MEMORY OF THE COMPUTER
ARE EXECUTED IN LOGICAL SEQUENCE
INSTRUCT THE COMPUTER AS TO
— (1) WHAT OPERATION TO PERFORM
— (2) WHERE THE DATA IS

Fig. 41

Fig. 42.

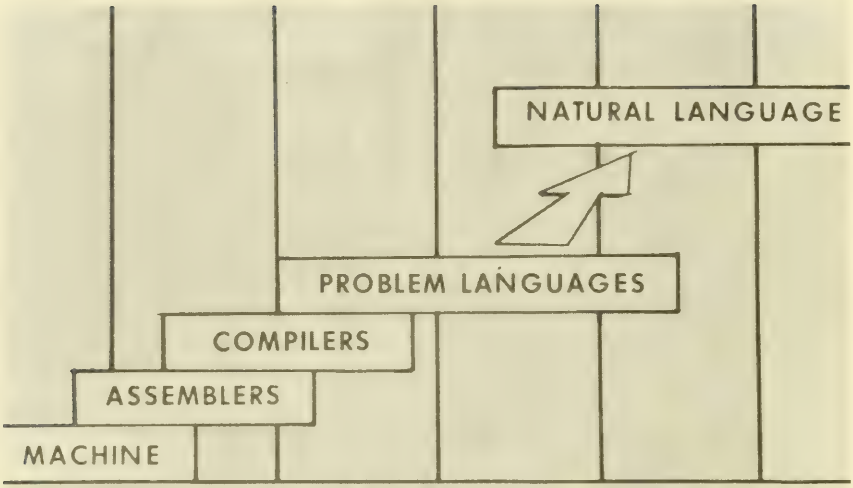

NATURAL LANGUAGE
PROBLEM LANGUAGES
COMPILERS
ASSEMBLERS
MACHINE

Fig. 43

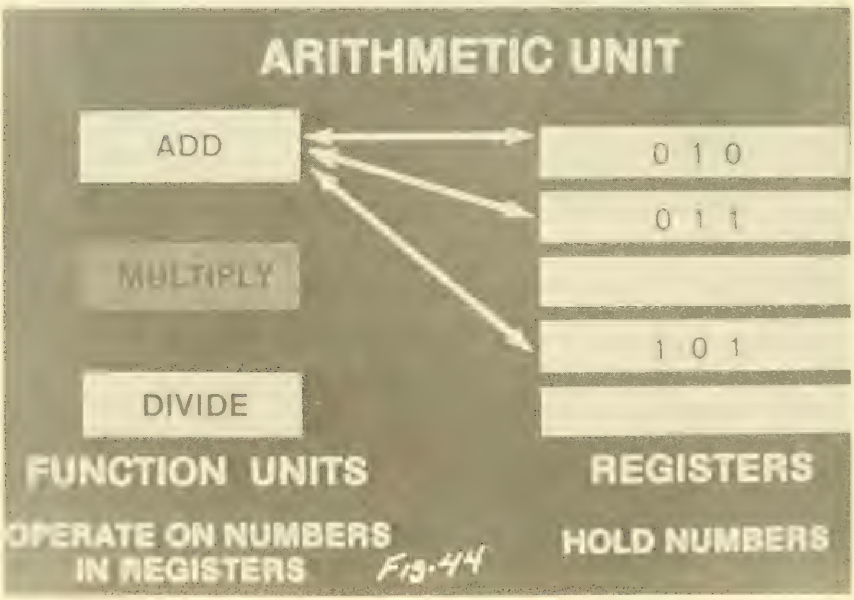

ARITHMETIC UNIT
ADD
MULTIPLY
DIVIDE
0 1 0
0 1 1
1 0 1
FUNCTION UNITS
OPERATE ON NUMBERS
IN REGISTERS
REGISTERS
HOLD NUMBERS

Fig. 44

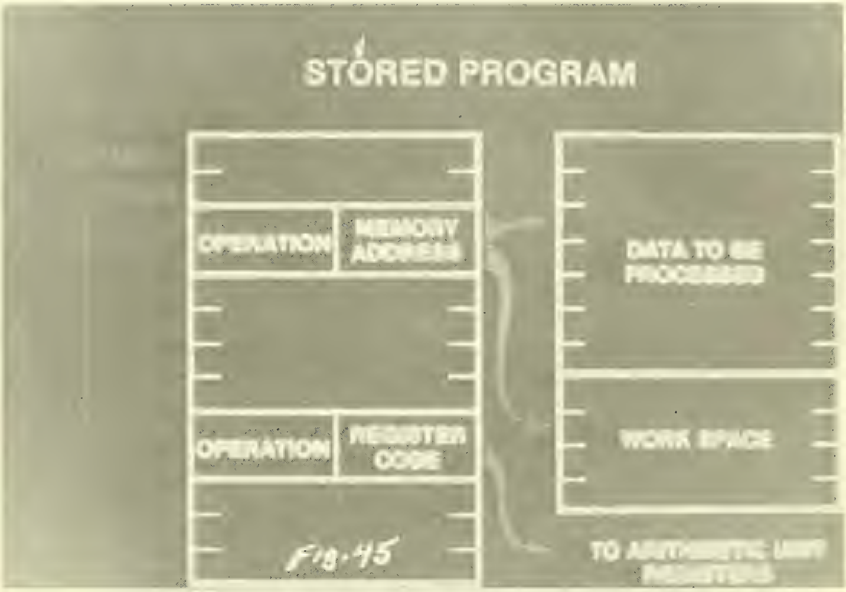

STORED PROGRAM
OPERATION
MEMORY ADDRESS
DATA TO BE PROCESSED
OPERATION
REGISTER CODE
WORK SPACE
TO ARITHMETIC UNIT REGISTERS

Fig. 45

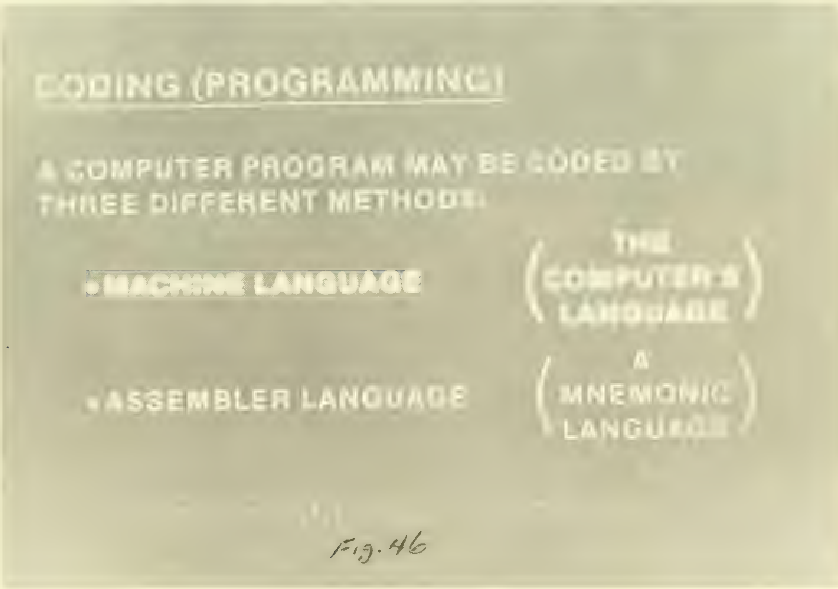

CODING (PROGRAMMING)
A COMPUTER PROGRAM MAY BE CODED BY THREE DIFFERENT METHODS:
• MACHINE LANGUAGE
(THE COMPUTER'S LANGUAGE)
• ASSEMBLER LANGUAGE
(A MNEMONIC LANGUAGE)

Fig. 46


Fig. 47

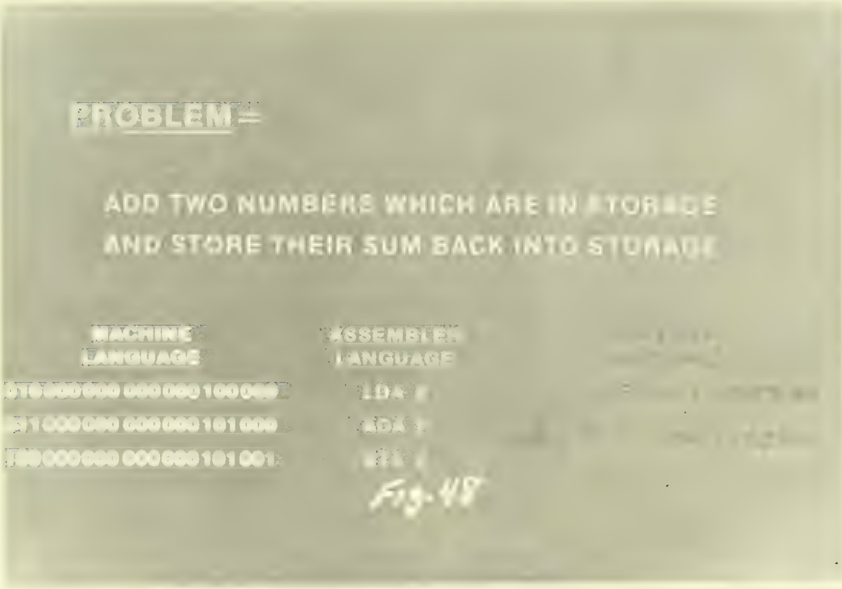

PROBLEM =
ADD TWO NUMBERS WHICH ARE IN STORAGE
AND STORE THEIR SUM BACK INTO STORAGE
MACHINE LANGUAGE
ASSEMBLER LANGUAGE

Fig. 48


24-BIT INSTRUCTION WORD
010000000
OPERATION
(9 BITS)
TO BE PERFORMED

Fig. 49

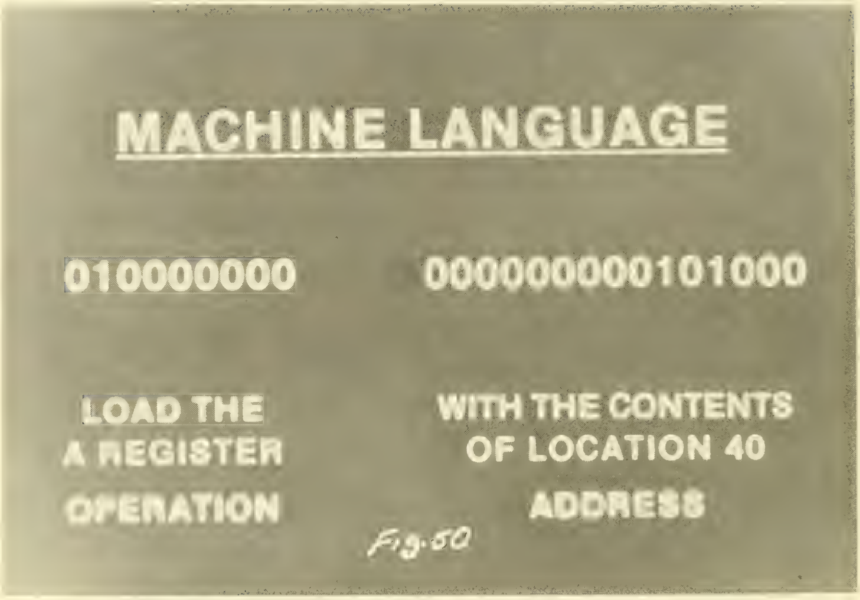

MACHINE LANGUAGE
010000000
000000000101000
LOAD THE
A REGISTER
WITH THE CONTENTS
OF LOCATION 40
OPERATION
ADDRESS

Fig. 50


ASSEMBLER LANGUAGE
LDA
X
OPERATION
ADDRESS

Fig. 51

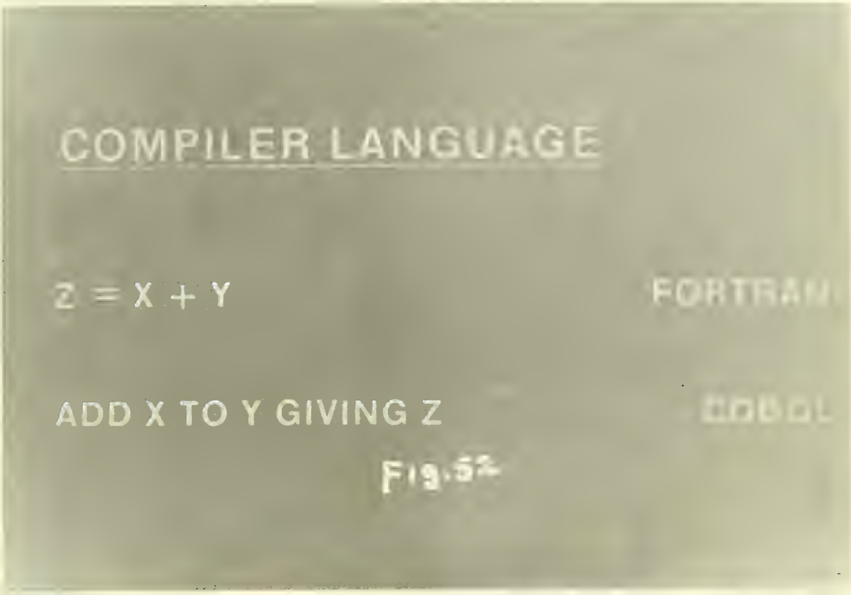


Fig. 52

Fig. 53


Fig. 54

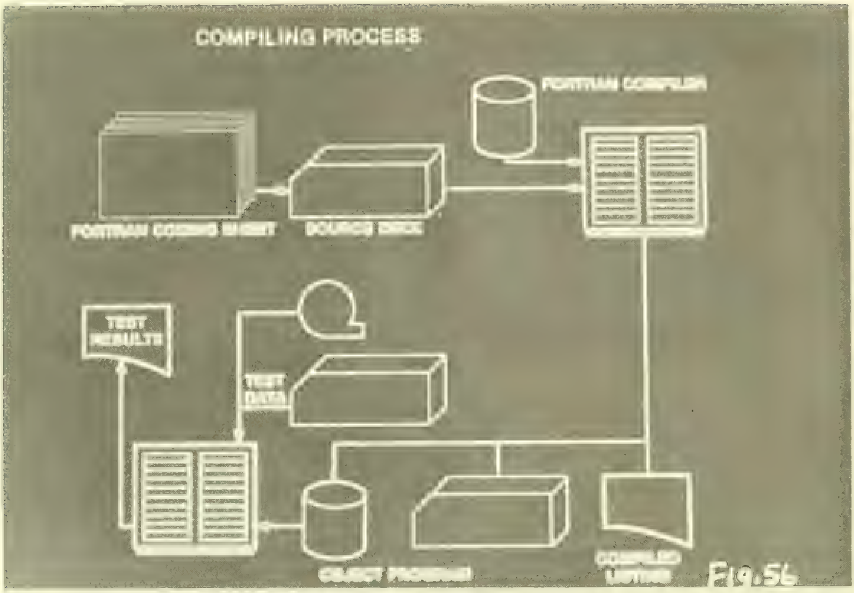

COMPILING PROCESS
FORTRAN COMPILER
FORTRAN CODING SHEET
SOURCE DECK
TEST RESULTS
TEST DATA
OBJECT PROGRAM
COMPILED LISTING

Fig. 56

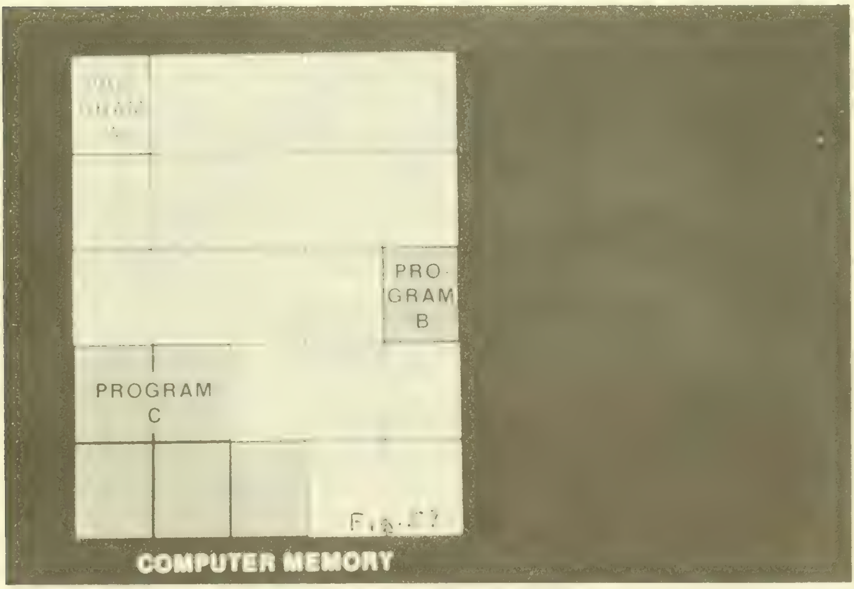
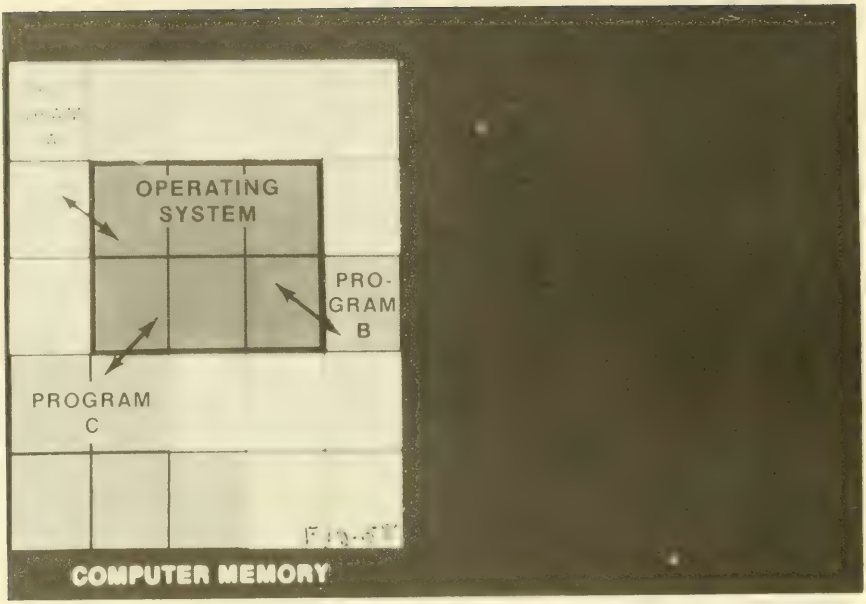

PROGRAM B
PROGRAM C
COMPUTER MEMORY

Fig. 57



OPERATING SYSTEM GOALS

- Provide Maximum Job Throughput
- Reduce Traditional System Overhead
- Provide Maximum System Resources To User
- Provide System Reliability
- Provide For System Maintainability
- Provide System Flexibility

Fig. 59


Man and Machine
both have a
Control Function
MAN CONTROLS
HIMSELF AND
INITIATES CONTROL
OF THE MACHINES

Fig. 60


MAN'S NERVOUS SYSTEM
CARRIES SIGNALS
THAT CONTROL
HIS ACTIVITY

Fig. 61


the Machine Controls
its Internal Operations
with Signals through
Electronic Circuits

Fig. 62


Man performs
an Output,
his Actions
WRITE . TALK . DO...

Fig. [illegible]

A COMPUTER PERFORMS OUTPUT BY...

- PUNCHED CARDS
- CHARTS
- MAGNETIC TAPE
- PRINTED PAGE
- PUNCHED TAPE
- DISPLAY SCREEN
- VOLTAGE FOR CONTROL OF OTHER ITEMS

Fig. 14

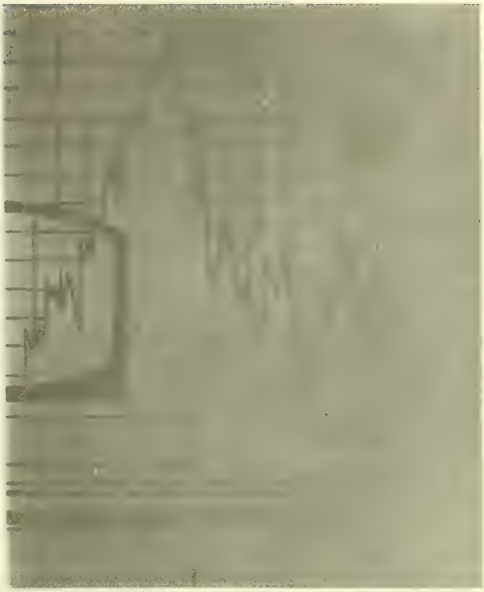


Fig. 65

Fig. 66

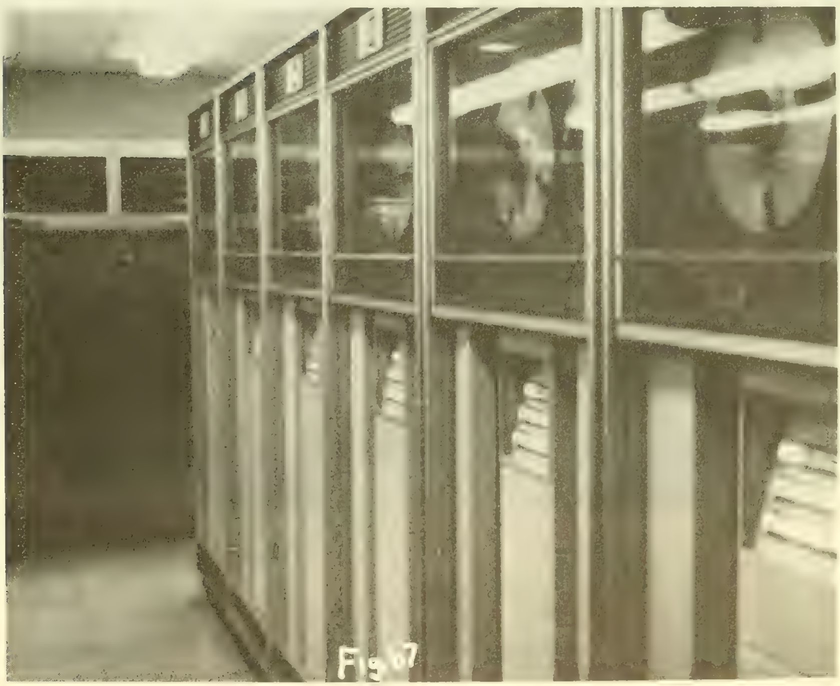


Fig 67

Fig. 47

Fig. 49

Fig. 70

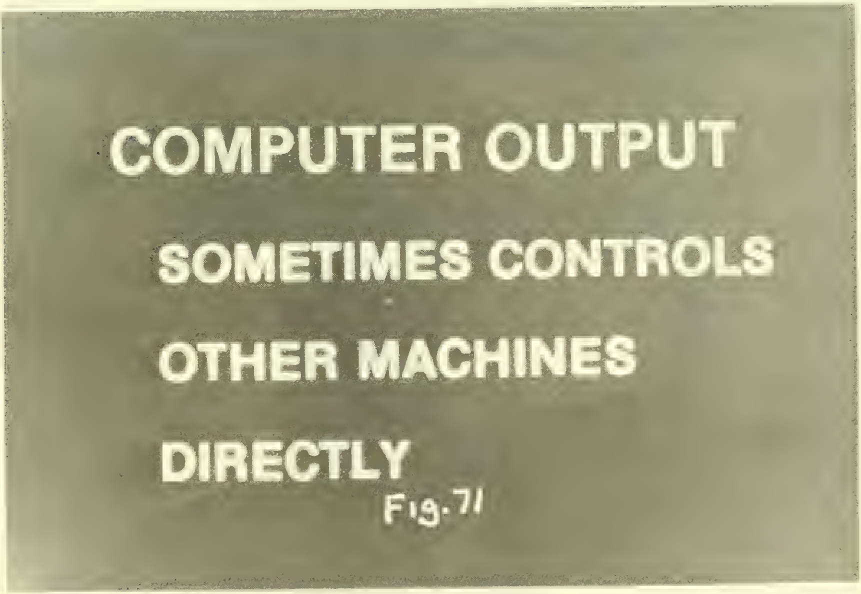

COMPUTER OUTPUT
SOMETIMES CONTROLS
OTHER MACHINES
DIRECTLY

Fig. 71

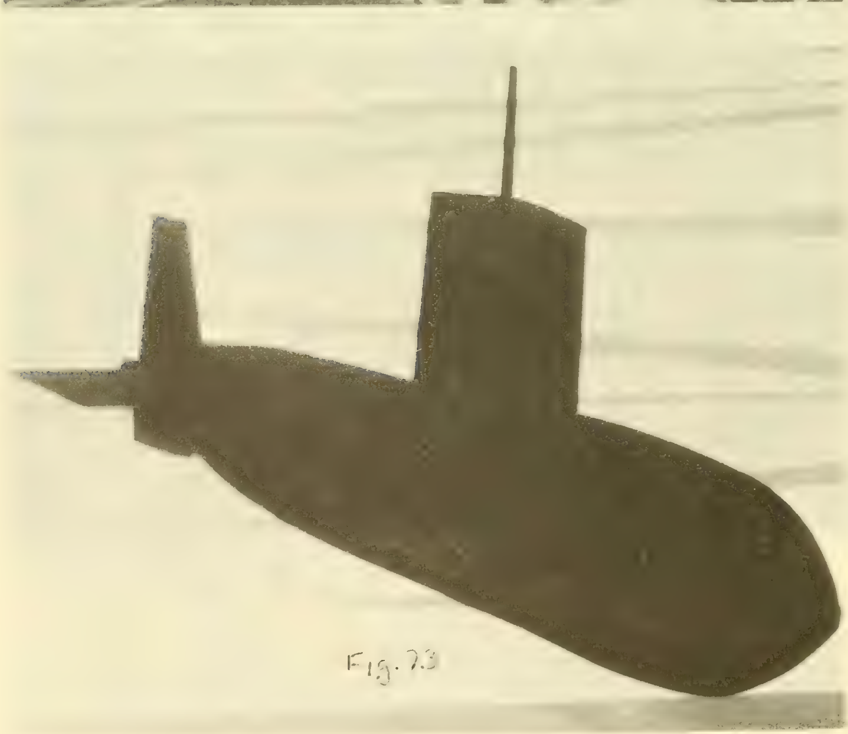


Fig. 73

Fig. 74

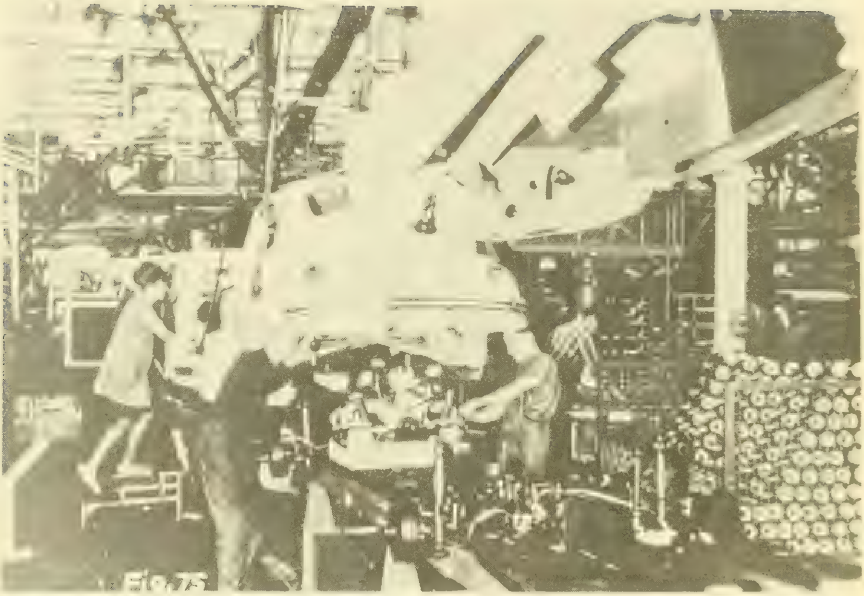
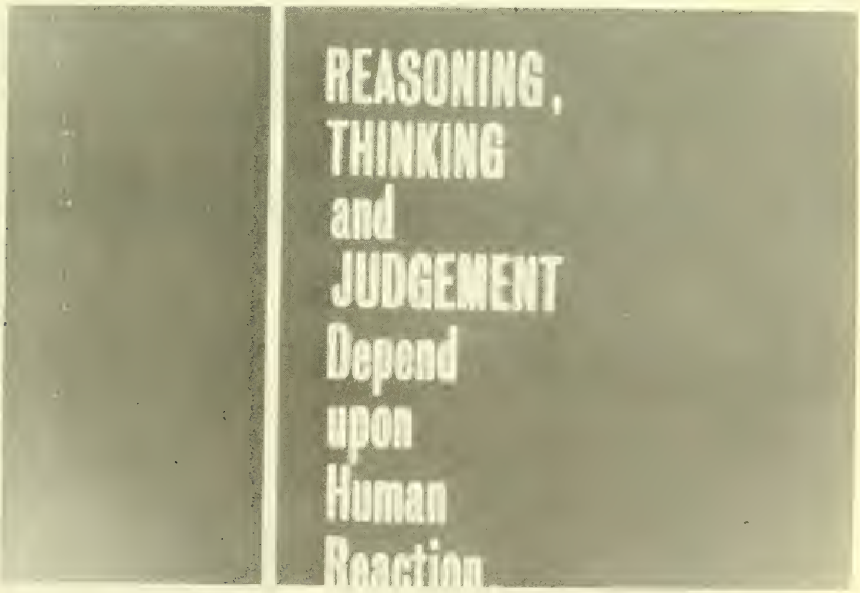


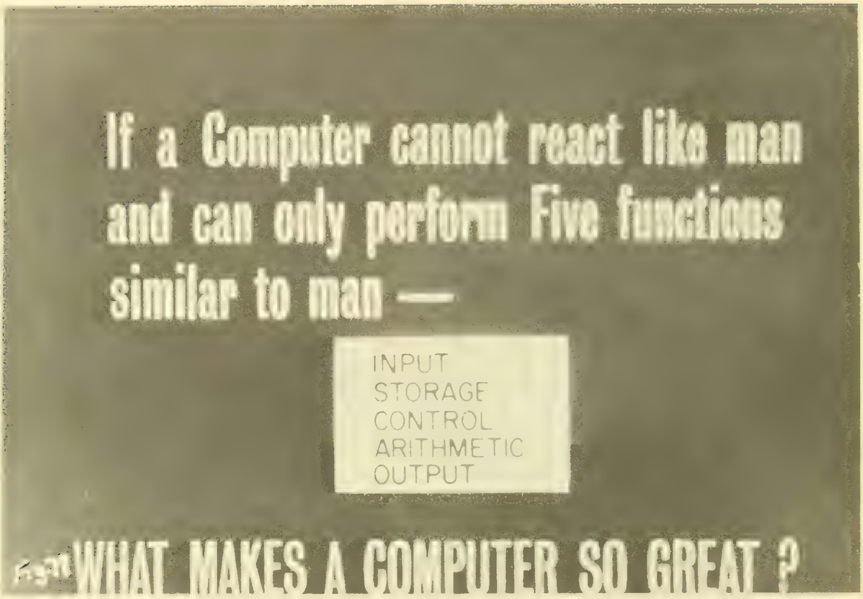
Fig 75

Fig. 76


a
Computer
CANNOT...

Fig. 77


REASONING,
THINKING
and
JUDGEMENT
Depend
upon
Human
Reaction


If a Computer cannot react like man
and can only perform Five functions
similar to man —
INPUT
STORAGE
CONTROL
ARITHMETIC
OUTPUT
WHAT MAKES A COMPUTER SO GREAT ?

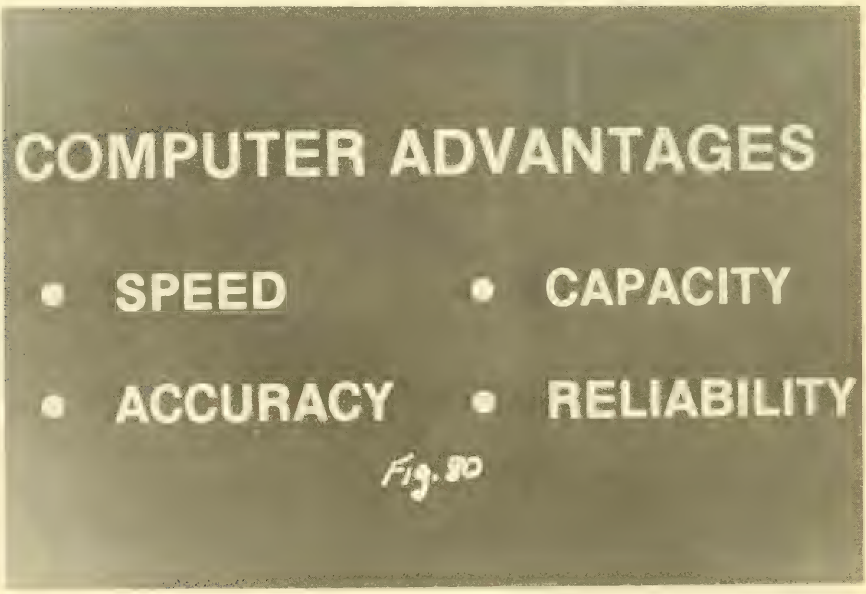
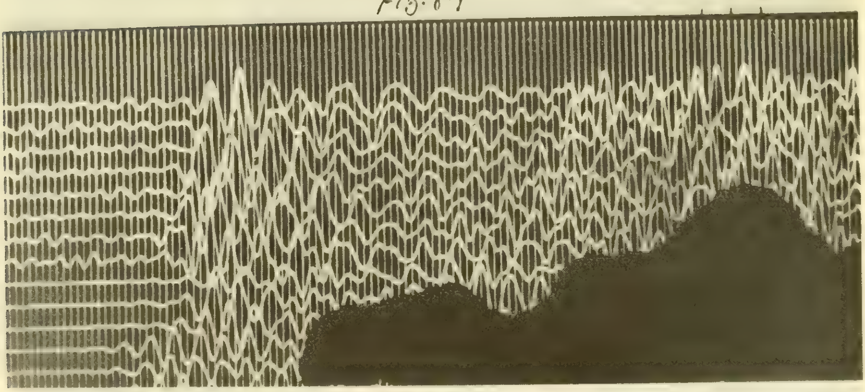

COMPUTER ADVANTAGES
SPEED
CAPACITY
ACCURACY
RELIABILITY

Fig. 80

Fig. 82

Fig. 83

Fig. 84



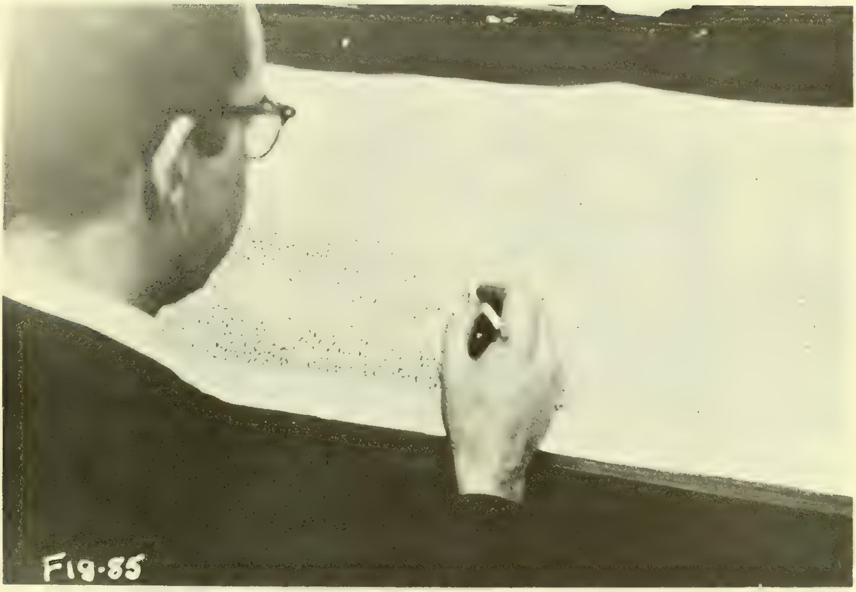


Fig. 85

Fig. 86


Fig. 87

Fig. 88

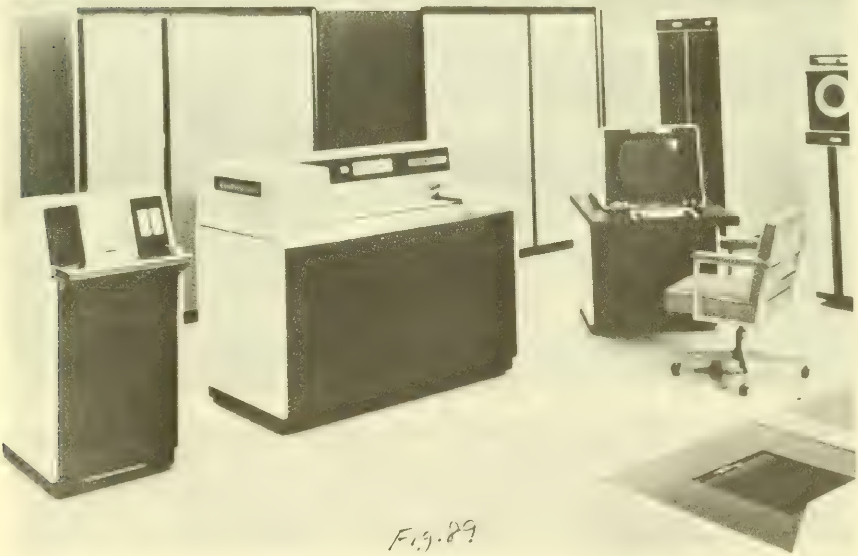
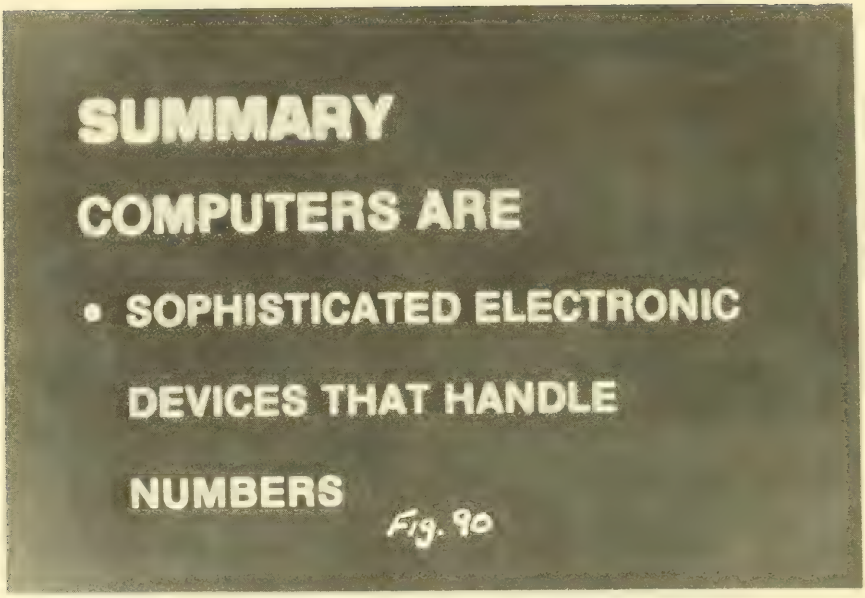
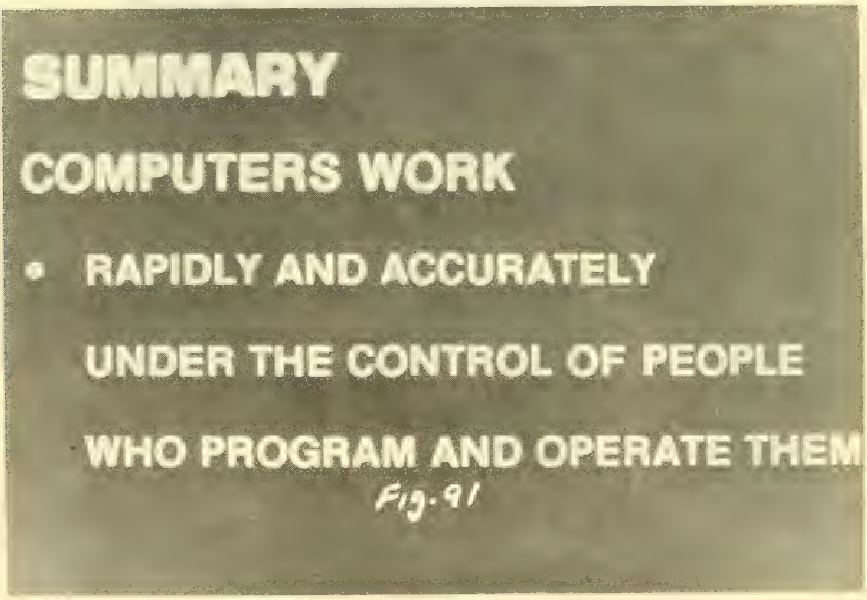


Fig. 89


SUMMARY
COMPUTERS ARE
• SOPHISTICATED ELECTRONIC
DEVICES THAT HANDLE
NUMBERS
Fig. 90


SUMMARY
COMPUTERS WORK
• RAPIDLY AND ACCURATELY
UNDER THE CONTROL OF PEOPLE
WHO PROGRAM AND OPERATE THEM
Fig. 91

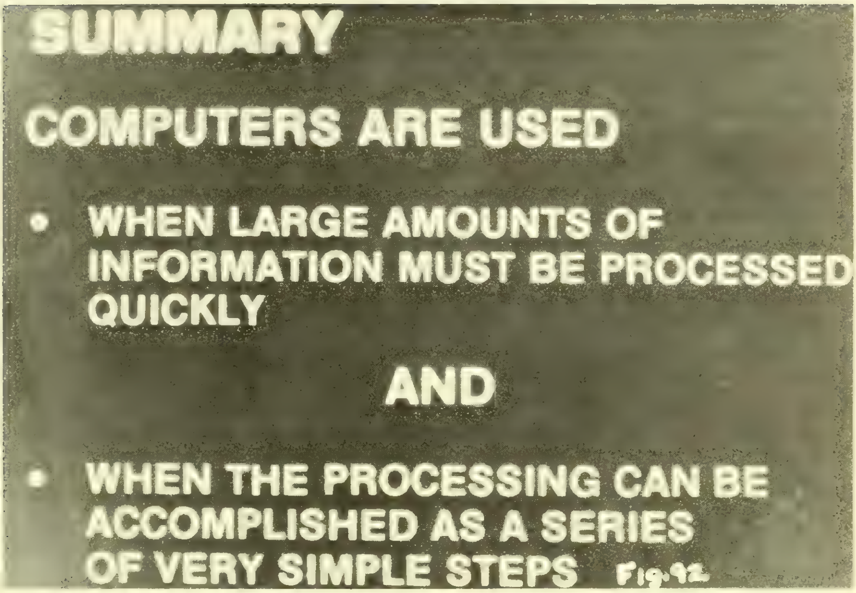


Fig. 12

Senator HART. The next testimony will be presented by Mr. James Peacock and Mr. John P. Breyer of the International Data Corp.

Mr. Peacock is the editor of the EDP Industry Report, a subsidiary.

Gentlemen, we welcome you.

We will order the prepared materials you filed with the committee printed in full.

[The material referred to appears as exhibit 1 at the end of Mr. Breyer's oral testimony.]

Senator HART. If you have any footnotes you would like to add, you may do it.

I should explain, lest the interruption jar you, at about 3 p.m. I will be compelled to take a recess, the reason being another committee is attempting to conclude the markup and action on a copyright reform bill.

You may proceed.

STATEMENT OF JOHN P. BREYER, EXECUTIVE VICE PRESIDENT, INTERNATIONAL DATA CORP., NEWTONVILLE, MASS.; ACCOMPANIED BY JAMES PEACOCK, EDITOR, EDP INDUSTRY REPORT; AND J. THOMAS FRANKLIN, COUNSEL

Mr. BREYER. Good afternoon, gentlemen. I consider it both an honor and a challenge to be here today as you begin your examination of the computer industry.

I have with me today Mr. James Peacock and J. Thomas Franklin, counsel to IDC and a member of the Boston firm of Sweeney & Franklin.

Under Mr. Franklin's guidance IDC has been active in the antitrust area as a consultant, witness, and reporter. And IDC's newest service is the IBM Antitrust Litigation Service, which reports developments in all the antitrust suits now involving IBM.

Our company, IDC, is 10 years old, half as old as the computer industry. During the course of the past 10 years we have devoted our professional lives to providing information about the computer industry.

This is our business. This is our only business. To accomplish this task we talk to users, talk to suppliers, listen to scientists and advance planners.

We look for the relationships between economic conditions, product offerings, general usage trends, and the increase or the decrease in the use of the many services and products that are sold to computer users.

We gather this information with mail questionnaires, telephone interviews, and personal interviews. The information thus obtained from users is compiled and then stored in a computer so that we can analyze it for our clients.

As a matter of fact, today, 10 years, and many client services later, the foundation of our work is still the computer census data file, the original product of our company.

This data file has been updated every 6 months since 1964, and it contains today a description of somewhere between 60 percent and 80 percent of all the computer installations in the United States and overseas.

One reason I stated such a wide range as to the completeness of our data files is that no one to my knowledge has an exact count on such information.

Data available from the industry is incomplete and unreliable. Annual reports and press releases are published by industry participants, but very seldom do they provide information on specific customers, product shipments levels, or the return of off-lease equipment.

For this reason, we believe the IDC data that is gathered from users directly is the most accurate and objective information available as to the actual use of computers.

We admit that our data is not as complete as we would like to see it.

We are, however, continually in the process of increasing the size of our data base, expanding the scope of our research.

We certainly feel we have our fingers on the industry's pulse. And by continually gathering information from computer users and analyzing the results we are in a position to provide objective, quantitative information and objective, qualitative observations to our customers.

Our products and services include the data files I have been describing, multiclient research studies on the computer industry, research services for top financial institutions in the United States, the publication of a weekly newspaper, Computerworld, and semimonthly newsletters such as EDP Industry Report.

We are international in scope and conduct research analysis throughout Europe and Japan.

Ten years ago, as IDC was starting its data file operation, it also began publication of EDP Industry Report, a newsletter popularly known as the "Gray Sheet."

This is IDC's flagship publication, and the best known vehicle for the dissemination of IDC's user and industry information.

At this point, I would like to reintroduce Mr. James Peacock, who has been responsible for editing EDP Industry Report for more than 7 years.

As editor of the Gray Sheet, Jim has been an astute observer of the development of the computer industry. I believe he is eminently qualified to provide this subcommittee with an overview on the history, current status, and future trends of the computer industry.

Mr. PEACOCK. Thank you, John.

Good afternoon.

I am going to be speaking from material in the background submission and from some posters prepared from it which we will be showing you, I will point out what pages we are on as we get to it.

But, primarily, it is built around that. To start with, I certainly want to point out that I share Mr. Breyer's sense of responsibility about this appearance.

You gentlemen are taking a look at several industries in an effort to determine their possible need for reorganization.

And I certainly don't envy your task. I hope that my presentation will be helpful. It is my full-time job to think about one industry, a multifaceted one to be sure, one that actually cuts across all other industries and virtually all human activity, including the Government, because its products and services have become essential to the very functioning of our society.

So I am very concerned about the future of the computer industry. I am concerned, personally, of course, because it provides me a way to make a living, but that is not what I am talking about. I am concerned about the future of this industry because I truly believe it holds the keys to progress for the world in which we live. I would not like to see this progress stifled by forces from within the computer industry; neither would I like to see man's ability to use computers hindered by artificial and unnecessary constraints on the continued application of computers to the challenges of the complex soicety in which we live. I certainly agree with you, Senator Hart, when in announcing this week's hearing you said, "I believe it fair to state that computers represent the central nervous system of our economy."

I would merely go one step further. Our computer nervous system is today truly embryonic. The capability of the computer has barely begun to be applied.

Technological factors that lie closely ahead will probably bring more change to the use of computers and, therefore, to our own lives than they have in the past.

But I am getting slightly ahead. You've asked me to describe the computer industry. U.S. companies today, from giant IBM, and other large main-frame manufacturers such as Honeywell, Univac, Burroughs, NCR, Control Data, down to the clever manufacturers of special terminals that we sometimes call information appliances, the systems houses that buy up minicomputers and mold them into problem-solving tools, down to the service bureau which is likely to be found in cities and towns of almost any size whatsoever, generated some $20 billion in revenues last year. Why? Simply because people today need computers.

That revenue which flows into U.S. corporate coffers from all over the world is increasing at about 15 percent annually, doubling every 5 years, doubling and quadrupling us into 1984, at least.

Why? Again, demand; user demand. Let's take a look. I really thought long and hard, from the day that I discovered the challenge you had extended to my company and me, about how to share with you the understanding I have of the computer industry.

I asked myself—

What is the best way to plump you down in the midst of this very complex industry, to let you see all the pieces and then help you put it together again, at least into a recognizable picture, and to do all this in a very few minutes, and to do it w'th no intentional bias?

It seems to me that the best way to give you this initial understanding is to look at users and how users spend their money.

This is something that IDC investigates by field research on a regular basis. So let's take a look at my first chart that the artist has put together for us.

That is the chart on page 12.* For the moment, don't worry about the details. Simply look at the four pies we have drawn.

[The chart referred to appears in exhibit 1 at the end of this panel's oral testimony.]

Mr. PEACOCK. Notice how these pies, representing U.S. user spending in billions of dollars, have grown over time. Just 15 years ago U.S. computer users spent less than $1 billion on computers, including the salaries of the people who they paid to run them.

Now, look at the growth in 5-year increments that we have shown, from less than $1 billion in 1958 to $4 billion just 10 years ago to about $12 billion, to the $20-billion level last year.

And we at IDC think we know enough about user spending patterns to forecast that this will approach the $40-billion level in 5 more years. That is even an acceleration and it is pretty dramatic, I think you will agree.

And, by the way, it doesn't even take into account any abnormal inflation such as that the country seems to be facing these days.

Studying the economy and things such as inflation is not my field of analysis, but I can read the newspapers and examine my own bank account. So I am somewhat comforted by the role the computer industry plays in our economy. Salary levels and user spending per employee are almost certain to increase. But computers, as you have been hearing already, will continue to provide more "bang for the buck," as people in the industry call it, as new technology is applied. The increases in productivity per employee will probably keep inflationary forces minimal insofar as computing is concerned. More and more, in fact, computer use will be the only answer to these and other pressures.

But let's return to the user spending chart, now. I put in the package of handouts some of you have a circle that cuts the 1973 figures into the major wedges.

We can see that just over one-third of user spending last year was on salaries. About one-third was for EDP systems. That is the actual computers themselves. And the final 30 percent was split among such items as services used by computer users as well as by people who don't need a computer all the time, supplies such as paper and magnetic tape, things that feed data in and out of computers, software, the instructions that tell the computer what to do. and finally, support, such as data entry equipment—like keypunches, communication lines, et cetera.

*See p. 4954.

I am not going to say very much about salaries today, gentlemen. That is the one thing that is not IDC's specialty. And I might note, however, that, as we spelled out in our background submission, the data about employment is extremely sketchy.

According to AFIPS—the American Federation of Information Processing Societies—which is about to publish a study, there are about 1¼ million jobs in the United States, jobs for people who manufacture computers, people who work with computer service companies, and finally, the people who operate computers within their own companies.

Today we are going to focus, as we have in our detailed background report, on the $13 billion in this 1973 pie chart here that is spent for things other than personnel in the United States.

We are going to add to that in our focus the $6 or $7 billion in comparable spending abroad that comes into U.S. companies.

So we have, again, another $20 billion pie that we are talking about, a revenue pie, but its pieces, or at least some of them, are somewhat different from the $20 billion on this chart.

For a start, we are going to take a look at the population of computers. It is a count, if you will, of how many boxes there are out there and what they are worth.

This second chart shows the historical buildup of computers and what we foresee in 5 years. It corresponds to page 30* of the background material.

You will notice that the blue, or the shaded part, represents the value of computers installed, and the light yellow or blank bars in the book represent the number of computers.

As you can see, there is a tremendous growth in the number of computers expected over the next 5 years: from 133,000 in this country last year to almost half a million.

The value of these is not going up as much because we are going to see an influx of small computers—lots of the so-called minicomputers you've probably heard about, as well as many more small business-oriented computers.

So you can see that the buildup—from either a numbers or dollars standpoint—has been dramatic in the past. But what lies ahead, as we measure it, is even more dramatic than anything we have seen in the past.

Therefore, I think this is an appropriate point to take a look at the various ways you can measure the size of the computer industry.

Senator HART. We have to recess. I apologize. I hope this rollcall will not run too long.

[Whereupon, a recess was taken.]

Senator HART. I do apologize, gentlemen. The debate was over copyright reform. It went a lot longer than we expected. Please go ahead.

Mr. PEACOCK. Just to review where we had been, Senator, we had focused on the user spending charts and the tremendous growth on the first chart there.

We said that from now on we are going to concentrate on the part of the user spending other than what he spends for personnel.

The next chart shows the computer population and growth, and you can see there is a tremendous growth in the number of computers

*See p. 4972.

expected over the next 5 years, from the 133,000 level in this country now up to almost half a million 5 years from now.

The value of these will not be going up as much, however, because we are going to see an influx of small computers—lots of minicomputers, lots of small business computers.

This buildup, both in numbers and dollars, has been dramatic in the past, but what lies ahead as we measure it is even more dramatic than anything we've seen in the past.

So, I think this is an appropriate point to take a look at how one can measure the size of the computer industry.

The chart we are looking at right now measures the value of equipment installed. What we at IDC do essentially is to count up the computers, figure out what the original purchase price of each one was, and multiply that out and add it up.

Unfortunately, this is not an indication of actual revenues. Likewise, any figures we can develop on what is normally measured in a hard goods industry—the level of shipments—are not exactly a true measure of the situation either.

Why? A large number of computers—a decreasing percentage today, but still a large number—are rented from the original manufacturer.

In other words, the equipment is built and the people who make it are paid, and the products are shipped out to the customers, who then start paying the manufacturer on a monthly basis at rates of approximately $1/48$ the value of the computer for each month they keep it.

So theoretically the computer is paid for after a customer keeps it operating for 4 or 5 years. And I said 5 years because the rental rate includes maintenance of computer equipment, and quite often that is a pretty substantial job—one that involves one or more full-time people to keep an eye on these big pieces of electronic gear.

This upkeep would be paid for separately if the computer equipment had been purchased by the user. Last year, as a matter of fact, users spent about 8 percent of the total dollars they paid out to computer manufacturers for the maintenance of equipment that had already been purchased.

This concept of the rental of capital equipment—the expensing of capital goods items—is one of the things that makes the computer industry, in my opinion, very different.

It is extremely important that you understand and appreciate the dynamics of a rental-based business. For one thing, it allows users great flexibility in their choice of what computer they are going to use and when they are going to upgrade or change models, and so forth.

This concept of independence—real or merely believed by the user—is probably one of the important reasons that computers caught on so quickly after they were introduced for the masses, as it were, in 1959.

On the other hand, the supplying of rental equipment means that a computer manufacturer must have funding, equity, capital with which to build the equipment, pay for the parts, pay the people who make it, and sustain his business operation until enough equipment has been out on rent long enough so that he starts to make a profit on his original investment.

In the long run, the supplying of rental equipment can be more profitable than the outright sale, because there is a good chance people will keep the equipment for a longer period of time than necessary to pay off the manufacturing costs. But it does require a large amount of capital, especially if a company wants to grow, penetrate the industry, and gain market share in whatever part of the industry he is competing.

I recall quite vividly, about 10 years ago, having long discussions with the head of what has become one of the major main-frame manufacturers. The question, simply: Can a company entering the computer business grow so fast that it will never make it—never get into the black—because it has to keep spending to increase market share in a rental environment?

He finally admitted this could happen, and as a matter of fact he actually had to slow his company's growth and obtain additional financing until rental revenues caught up with operational and manufacturing costs.

Up to this point we have implied there are two ways for people to acquire computers: buy them, or rent them from the manufacturer.

There is a third technique, one that came into vogue in the computer industry during the mid-1960's. It is the concept of the third-party lease.

This is not an unusual business arrangement, although there seems to be some question as to whether it is the most viable in a high-technology industry.

You know how it works. A company with excess capital, or equity, goes out and purchases computers that a specific user wants or that the company thinks a user will want.

It then supplies the computer to the user at a monthly rate that is less than the rental charged by the manufacturer. The economics of this technique, according to the prospectuses that many of the companies used to raise the funds with which to operate, is the fact that a computer has a much longer life than 5 years.

These leasing companies think that the computer has an 8- to 10-year life. So they write contracts, set their rates, with the prospect of getting the purchase price of the computer, plus a profit, either from the original person who leases the computer or from a subsequent lessee.

Some leases are written as full payouts. Others are shorter term, sometimes only 1 to 2 years. These shorter term leases are called risk leases or operating leases, and some of the people who wrote these back in the mid-to-late 1960's have had second thoughts once 5 years or so passed and the original manufacturer, operating as it were on a planned, 5-year cycle, has introduced a new family of computers, computers with—here again—more bang for the buck, which we see in technology today.

Some of these third-party leasing companies have been forced by their accountants to take write-downs on the book value of the computers they originally acquired under such a scheme. And one of the most pertinent comments on the concept is that there is, with some exceptions of course, a different group of companies leasing computers today than the original set. They are primarily writing medium- to long-term leases this time around.

The leasing concept blossomed shortly after the introduction of IBM's System/360. This family of machines quickly became the norm, as it were, and it looked to the lessors as if the system's popularity would guarantee a long marketplace acceptance.

This has been true to a great extent, but the marketplace acceptance for 360's today is at a price considerably lower than their original value.

So it may take the lessors longer to recoup their money than they originally planned. Some of them, of course, have managed to do all right.

Let us now take a look at the computer systems marketplace, that 35 percent of the user spending pie from about 12 to 4 on the clock.

We will consider this to be the whole pie in the next chart that we are going to look at.*

This pie chart actually shows several things. The big piece, representing slightly over three-fifths of the system's pie, we have identified as IBM systems. This is that group of equipment that was either built by IBM or was designed to operate with equipment built by IBM, and it can be further separated into four pieces.

The first is the equipment currently owned by IBM and rented to users.

Next is the equipment previously manufactured and sold by IBM to users and theoretically available for use in any way the current owner chooses.

Next is the equipment originally sold by IBM to a third party who has ultimate control over the system even though the user—as in the case of a user who has bought his equipment directly from IBM—the case just above—will probably keep up with the operating procedures specified by IBM for its own equipment.

Finally, in that segment, there is equipment originally built by PCM's—plug-compatible manufacturers—to operate directly with IBM main frames with as much or higher performance than the IBM counterpart.

We can also look at this same big piece in a different way that I have not shown on the charts. Taking the cut of the IBM system's base, we find that 5 percent of the equipment, a very small amount, is old—built back before system/360 started to go in about 10 years ago.

Thirteen percent is the small equipment like IBM's System/3, or the control-type computers—IBM System/7—similar to the minicomputers we will discuss in a moment.

So that essentially takes almost 20 percent out of this pie. The remainder, we have 32 percent—just below one-third of IBM's installed base—is System/360; 7 percent is that—as we discussed above—built by the plug-compatible manufacturers; and the remaining 43 percent is System/370, the family IBM introduced in 1970 and first delivered in 1971, just 3 years ago.

That shows you how fast users tend to move up with their equipment.

Getting back to the big pie on the chart, the remaining 37 percent is split among seven main-frame manufacturers as shown and the more than 50 minicomputer and dedicated application computer manufacturers who have built more than half the computers installed in the United States by number, but that represent less than 5 percent of the installed base by value.

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*See p. 4973.

You can see there are two different ways of measuring what is going on. So that is the way the systems pie looks in the United States.

On the next chart we are going to relate this $30 billion worth of U.S. computers with the remaining $20 billion that are installed throughout the world.

This chart, I hope, is not too confusing. It is designed to show a couple of things.

First, this big pie represents the $50 billion worth of computers installed in the free world, the non-Communist world, at yearend 1973.

The most striking thing to me about it is that only about 10 percent of the equipment was built by a non-U.S.-based manufacturer. The European computer makers and the Japanese computer manufacturers have supplied about 5 percentage points each of the world supply of computers.

Second, you can see that U.S. computers only account for about 55 percent of the total. I am not going to try to get into balance-of-trade questions here, but I hope this chart will give you a feeling for what I suppose you will be hearing later on this week.

In a nutshell, the United States uses just slightly over half the world's computers; but U.S. companies have made 90 percent of them.

Third, as you can see on the chart, of the worldwide total, 61 percent—just over three-fifths—are IBM systems, some of which are owned by IBM and on rent, some of which are owned by users themselves, some of which are leased by third parties—and that includes banks abroad and other financial institutions—and some of which were manufactured by a plug-compatible manufacturer to attach into the central box made by IBM, just as in the U.S. chart I explained briefly a few minutes ago.

Before I attempt to get out any crystal ball and describe where things might be going in the computer industry, I'd like to ask you for just a minute to think back to the user-spending chart we started with.

If you will recall, we haven't really yet mentioned that 30-percent wedge of the pie, the wedge almost as big as this systems pie we have been looking at here just recently, just describing.

This other sector, as the user-spending pies describe, represents various types of support and alternative spending done by users and nonusers of computers—nonuser being a person who doesn't have a computer in his house but uses computer power from time to time.

On a percentage basis it is a bigger piece of the much bigger pie in 1973 than it was of the 1968 pie. Incidentally, that figure in 1968—24 percent—is lower than it was the two prior time periods mentioned.

This happens as one support area, such as supplies, keeps decreasing in relative importance while others grow. There is a pattern in the shift, however, and it is a growing percentage for services.

Today—and we think more so tomorrow, according to the user studies we do—services represent alternatives to the ownership of computers, and according to IDC's estimates will continue to grow as a percentage of user spending.

This sector also includes the user spending for communication lines and the various adaptors or modems he must use to pipe his computer's messages over the telephone lines or to a satellite and back to another part of the world.

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In general, the support portion of the pie will continue to grow at the expense of systems spending.

I have now just given you my best 20-minute summary—with a slight pause—of what the computer industry is today, how computer users spend their money, how the money spent for computer systems is split among the various manufacturers in various countries.

I would, however, feel negligent in my duty to this subcommittee if I didn't take just a few moments to share with you my educated guesses as to where things might be going.

As a framework for doing this, I believe we have to take a look at computers and computer equipment. After we see what the technology holds out, perhaps we can define how it might affect the industry.

My last chart of the submitted background material is called "Generations of Progress."* It is an attempt to put on one piece of paper highlights of what computers and computer use, and computer acquisition and the alternatives available at a point in time, are all about.

It is strictly my invention, if you will, and as such it may not be precise to some of the technologists who will follow me in this seat. But I find it useful.

Across the top I have broken the history of the computer industry into time periods, or generations, of roughly 5 years each, a little longer at the start, and no cutoff date for the future.

I think the dates are generally accepted ones. I haven't begun to list specific products on the big chart up there. In general, as the typed version in your book indicates, we had the named machines at the beginning of the computer age; the large, slow, clunky monsters that ushered in the age of the computer.

In a sense each had a personality, and few of any particular model were built. It was during this time period that some very important people were saying that 2 or 3 dozen of these machines would take care of the world's computational needs.

At any rate, we have gone from these scientific wonders of the middle 1950's—machines with names like Eniac and Alwac and Univac—to the business-oriented second generation computers, epitomized by IBM's 1401, that brought data processing for the first time to many businesses.

And then, finally, we stretch across that line to families of machines that each manufacturer offers today. Looking out to the future, it appears that the concept of network computers—as I will mention as we wander down the chart—and networks of computers will change today's concept of just what a computer is, anyway.

Coming down to the next line we have electronics, the circuitry used within computers. This is what led to changes being called generations, because during the time period involved very different and distinct generations of electronics were coming along.

In the past 20 years we have seen electron or vacuum tubes replaced by transistors, and these discrete transistors replaced by integrated circuits, and the drive for the future will be to make it smaller and faster.

In the main memory area, delay lines quickly gave way to rotating drums. By the late 1950's the magnetic core was introduced to hold

*See p. 4950.

the computer's information, and this was the norm, in improved versions, until just the last few yea.'s when semiconductor memories of various types have begun to be accepted.

In the labs scientists are talking about combinations of circuits and memories that operate at temperatures near absolute zero but that put the power of today's largest computers, or even more, into space the size of a desk drawer.

Auxiliary memory—the device that is used to hold information that is needed only on an occasional basis—has progressed from decks of punched cards to the tapes so often used to symbolize the computer to large disk stacks, much like phonograph record collections, and to mechanical tape libraries.

Clearly on the horizon, as a very large auxiliary storage device, is the Bell Lab invention called the "bubble memory." In fact, these should be coming down the road in a few years.

Data entry has gone from the card punch, which will remain still the most populous input method for another few years, to various key-capture units to the concept of direct data entry.

Output has progressed from the "flashing light" era of the early computer to faster and faster printers. In the future, with management by exception techniques being applied to the computer, rather than getting reams of paper we will begin to get only meaningful documents or displays.

Also, paralleling this development, we will have action output, like direct control of machines—which we have somewhat today—automatic transfer of funds, and so forth.

The architecture of computer systems, the very way their elements are put together, will continue to move from the classical combination of processor, memory, control circuits, and input/output that you have heard described by the people from Control Data, to a network concept, a network oriented around a vast memory, around which many special-purpose and general-purpose processors are hung and all of which is really determined by the operating system—the instructions that tell the computer how to work with the various elements that make it up.

Throughout all of this movement there will be a thrust toward what is called "transparency," the provision to the user of a system that he essentially can't see, and doesn't have to understand; a system that provides answers.

We believe users won't really have to worry about bits and bytes and binary arithmetic that much anymore. Along with this answer-orientation I would expect that manufacturers will begin to price systems not by the box or by the pound, the way they do today, but by the transaction.

We at IDC, in fact, are so convinced that the general movement toward the automation of business transactions is coming that we have started a newsletter and are looking at other products—at information needs in this area.

As the Nation's monetary system and various reservation systems get connected with credit and retail systems and hospitals and hotels and insurance programs, as this autotransaction concept takes off and eventually brings the advantages of data base access into the home, things will change.

There will be the true possibility of alternatives to owning a computer. Certain manufacturers—Control Data, in particular—have already stated goals along these lines.

The timesharing companies, the turnkey systems houses answering specific problems with tailored products, even large companies not closely identified with the computer industry today, yet strongly considering vast service operations, all of these people will compete for the increasing computer dollar. Many of them will begin to offer valid alternatives to computer users.

For the user who wants to continue "doing his own thing," however—and I am practical enough to admit this will be the majority of users for quite some time—there are questions that lie ahead.

The next round of applications that many computers are planning require real-time involvement of their business operations.

Users will be able to put up with slowdowns, but not with failures. They will be extremely concerned by security. They will have so much money invested in software—programs or instructions for their machines—that they may not want to rock the boat. The language of computers in a few years may or it may not be conducive to shifting main-frame manufacturers, or to shifting even from one service supplier to another.

Today it often isn't conducive to this, and I don't really know whether it is actually possible on an easy basis.

I fully understand the task facing you gentlemen if you elect to take any action concerning the computer industry.

I would hate to count up the hours I have spent in conversations as to what might be done to the industry if something were to be done.

I often come to the conclusion that if we leave the status quo alone and give a still growing industry a chance to settle down, that the situation will rectify any inequities out there in the marketplace, assuming, of course, that proper rules are laid down and followed.

Others argue that this is impossible, that a single force has become too large to be upset by natural means. I truly don't know whether this is true or not.

I do know that it would be very dangerous for our country, if not for the world, for anyone to act without proper insight and understanding about this industry.

So if nothing else, I would like to urge you to try to appreciate the many forces at work in the computer industry. Often the answer offered by one group would work to the detriment of other industry participants if it were implemented.

During the many hours of thinking about what I might say to you I wondered if I could really offer any answers. Unfortunately, I must only complicate your task.

But I do want to stress, in closing, that we are dealing with a large investment by the computer users of this Nation.

This is an investment not so much of money—they are getting value from their $30 billion worth of computers—but an investment of skills.

The salaries paid programers and systems analysts over the years have gone to the capturing of business skills, the thinking through of problems, adapting these for particular computers.

No matter what happens users can't afford to toss out these captured skills. That means that they must have confidence in the future of their computer equipment manufacturer, no matter who it is.

Thank you very much.

Senator HART. Thank you very much, Mr. Peacock.

That, I think, was a very responsible, self-disciplined kind of analysis. It is not always the case in these hearings that we have a witness who measures up to that. It was very nice to hear.

Mr. PEACOCK. Thank you, sir.

Senator HART. Mr. Breyer, did you have anything you would like to add?

Mr. BREYER. No.

Senator HART. Mr. Franklin?

Mr. FRANKLIN. No thank you, Senator.

Mr. NASH. I must apologize for the lack of questions, but the magnitude of these statistics are such—and due to the inefficiency of our postal system, as you know, we just didn't get copies until late this morning—that we couldn't grapple with the statistical information which is quite thorough. I am sure it will be useful for the record.

One thing that occurred to me, though, relates to the type of information available in the public domain. I have never really seen such an aggregate of information as you have put together. I have checked certain Government agencies to see what they have available. I was wondering whether you might make any observations about the availability of information on the computer industry?

Mr. PEACOCK. Well, I think you put your finger on it. There is very little—as Mr. Breyer stated in his opening comment—there is nothing available from the manufacturers.

We have made it our business to collect this information. This probably is the biggest single collection you have seen. We tried to get information we could share with the committee and put it together.

I don't know that there is that much Government information, if that is what you want to know.

I don't find it readily available. Tom, do you have any comment on that?

Mr. FRANKLIN. No.

Mr. NASH. What accounts for the secrecy surrounding the information about industry structure that seems to prevail? Do you have any opinion on that?

Mr. PEACOCK. It has to do with the competitiveness, I am sure; with the fact that it is a rental-based industry, that most of the customers are subject to changing systems on momentary notice, and the built-in reluctance of manufacturers to disclose their information. This has been true with every one of them up until just recently.

A few have started breaking out certain things, I think, preparing for the revised SEC regulations. There is a little bit more broken out, but this has been true. Records weren't kept.

I mentioned I found this talking with the AFIPS person who put together personnel figures. There was just nothing existing before 1970. We have been trying to do it and have a good data base to start with, but somehow, even some manufacturers say they can't even track down all their equipment in terms of putting together accurate details.

Mr. BREYER. I would just like to add that all our information, as we mentioned before, is coming directly from the user. We get very limited information from the manufacturers themselves.

All our measurements are coming directly from the marketplace, from the people who use computers or plan to use computers.

We, ourselves, have great difficulty in obtaining official information on U.S.-based installations. We have no luck in the international market, either.

Mr. PEACOCK. I would like to add one comment on that also, and that is that even with available data it is hard to put together. We had available to us after the Telex versus IBM proceedings a tremendous amount of data, and yet even within the IBM internal documents that were disclosed there were inconsistencies, there were definitional things that we didn't treat the same way; people don't measure things the same way.

And as I have tried to show in the presentation here, there are many, many ways of measuring what is going on, and people start keeping them one way or the other for their own use. So this is another complicating factor.

Mr. NASH. Thank you very much. No further questions.

Senator HART. Mr. Chumbris?

Mr. CHUMBRIS. Thank you very much, Mr. Chairman.

I would like to state that you do have quite a document here and, unfortunately, because of the mailing, it didn't get to us until this morning.

I discussed it with you gentlemen informally while we were in recess. You do have much statistical data. I noticed one thing we discussed earlier, that the number of computers will go from 133,000 to 481,000, which is over a 250-percent increase in a 5-year period.

The value is increasing almost less than 2 to 1, which indicates that your computer will be of a smaller size and, therefore, the difference in the value.

This is an indication of the growth of computers from the early 1950's to now, getting smaller and smaller in size as the indication we had earlier with the exhibit.

Mr. PEACOCK. That is correct, sir. If you would look on page 32* in your book, I might point out something else that is happening.

This is a breakdown of computers by size class. We based it on how much is paid for it on a monthly basis, and as you can see, in the very small classes, a tremendous number, and in the very large class there is not many, but there is a tremendous dollar amount.

Now, our studies lead us to conclude that over time we are going to see increases in both of these pockets, so that the dollars will be pushed up reasonably fast by these very, very large computers, but not too many of them, while the numbers grow extremely fast by the very small computers.

Mr. CHUMBRIS. Yes. And I notice also a chart which would bring me to a second comment. I notice on the bottom of the chart you have U.S. number of units—62 percent rent, 24 percent own, 16 percent lease. Dollar value of units—43 percent rent, 36 percent own, 21 percent lease. On international basis number of units—69 percent rent, 25 percent own, 6 percent lease Dollar value of units—64 percent rent, 29 percent own, 7 percent lease.

I think the question of whether it should be rented or bought is an issue we will probably hear more of later in the hearings.

Mr. PEACOCK. I would think so, sir, and I am glad you realize the difference between the numbers and dollars. That is very important.

Mr. CHUMBRIS. Yes, thank you very much.

Senator HART. Gentlemen, thank you very much.

[The following was received for the record.]

*See p. 4974.

MATERIAL RELATING TO THE TESTIMONY OF MR. BREYER

Exhibit 1.—*Prepared Background Material Submitted by International Data Corp.*

FOREWORD

This document is submitted as background material in connection with the presentation being made to the Subcommittee on Antitrust and Monopoly, Committee on the Judiciary, United States Senate.

Representatives of International Data Corporation appearing before the Subcommittee will be explaining the techniques and concepts IDC uses to conduct its continuing study of the computer industry and the industry's many elements. The idea is to establish at least one intellectual framework within which the industry can be examined on a consistent basis.

In preparing this document for submission on a very tight time schedule, IDC has extracted material from many of its research projects. Because of the exact time at which they were completed, estimates or projections may have changed slightly. This reflects the very nature of the industry and the inexactitudes which surround information about it. The reader of this submission, therefore, is requested to use the information for the purpose for which it was assembled -- as a description of the many facets of the computer environment, and the interrelationships involved.

IDC QUALIFICATIONS

International Data Corporation provides the technical community -- both vendors and users -- with independent, objective, and reliable information services. As management consultant, analyst, researcher, and publisher, IDC builds a bridge of knowledge between the information-using community and those who market to it.

Management Consulting

IDC provides subscription services to institutional investors and corporate planners throughout the industry. It sponsors continuing programs that:

- Forecast overall industry trends;
- Project short-term and long-range sector development;
- Evaluate market potential for specific products and services.

Its written reports, seminars, private consultations, special studies, and telephone "hot-line" services attract security analysts and top-level management from financial houses, manufacturing companies, and service organizations located here and abroad.

Market Analysis

IDC executes a broad spectrum of custom research and joint-sponsored market studies for a variety of industry clients -- mainframe and peripheral manufacturers, software-service-and-supply companies, leasing organizations, government institutions, and financial houses. Its research staff, composed of full-time professionals with years of industry experience, designs and implements the projects -- in consultation with IDC clients -- and then presents the findings in written reports and personal presentations. The scope of such projects range from extensive overviews, estimates, and forecasts of total market sectors to in-depth probes of specific product acceptance, price sensitivity, and technological evaluation.

Information Collection

IDC is the census bureau of the EDP community. Since 1964 it has monitored the industrial, commercial, financial, services, and governmental sectors -- listing, in computerized form, the site

characteristics of thousands of EDP users in the United States and 122 countries around the globe. Formatted into proprietary data files, these listings detail -- for each site -- the user's exact equipment, configuration and associated peripherals, operating systems, languages, and off-line data capture devices. Updated semiannually, these files constitute a virtual census of United States and international EDP activity. They form the base for sample selection, market extrapolation, historical assessment, and trend projection used in much of IDC's professional analysis and evaluation. Moreover, they are used -- in raw form -- by manufacturers, service organizations, governments, and even other market researchers who consider them the most complete directories available of worldwide computer use.

Publisher

For participants, investors, and customers in the computer industry, IDC publishes three market-oriented newsletters, EDP Industry Report, EDP Europa Report and EDP Japan Report, and the weekly newspaper Computerworld. In 1973 IDC recognized the importance of new transaction-oriented equipment and service markets and inaugurated Autotransaction Industry Report. These publications facilities extend IDC's data gathering operations and ensure that analyses are optimally up to date. They also provide additional perspective in relating individual market sectors to overall trends.

IDC can provide this diversity of information services because of the expertise of its professional staff. This staff includes senior people with years of previous experience in the engineering, marketing, product planning, product development, research, and service divisions of major industry organizations. Moreover, they and other IDC personnel are trained specialists in research design, sample selection, questionnaire construction, interview techniques, statistical analysis, content analysis, market extrapolation, and economic forecasting. This combination of professional skill and market knowledge is one of IDC's major resources.

International Data Corporation is headquartered in Newtonville, Massachusetts, and has offices in New York, Los Angeles, London, and Tokyo.

"GENERATIONS" OF PROGRESS

GENERATION	EARLY	SECOND	THIRD	TODAY	FUTURE
DATES	1951-1958	1959-1964	1965-1970	1971-1976	1977-----
PRODUCTS	"Named" Machines	Business Oriented	Families------------------------------		Networks----------
ELECTRONICS	Vacuum Tube	Transistor	Hybrid Circuits/Integrated Circuits/Large Scale Integration		
MAIN MEMORY	Delay Line/Drum	Magnetic Core	Core/Plated Wire	Semiconductor	
AUXILIARY MEMORY	Punched Cards/Tape	Drum/Tape/Disk	Improved Disk/Tape	Advanced Disk/Tape Library/Bubble Memory	
DATA ENTRY	Paper Tape and Punched Cards		Punched Card/Key-to-Tape/Shared Processor/Direct Data Entry		
OUTPUT	"Flashing Lights"/Slow Printers/Line Printers/Tape/Display/Disk/High-Speed Printer/Documents/Action				
ARCHITECTURE	Logic+Memory+Control+Input/Output		+Larger Auxiliary Memory+Teleprocessing+Multi-Processors		
PROGRAMMING	Brute Force/Assembly Language/Compilers/Operating Systems/Emulation/Data Base-Network Processing				
			Software Packages	On-Line Guidance	Transparparency
USES	Computation	Financial DP	Information Processing	On-Line IP	Answer-Orientation
ACQUISITION	Purchase--				
	Rent--				
			Third-Party Lease (Short- or Long-Term)------------------		
					"Unit" Pricing----
ALTERNATIVES	"Borrow"	Service Bureau	Time Sharing/Remote Service/Minicomputer/Turnkey System		

CHART 100

DEFINITIONS

Various terms used throughout this submission may appear to be self-explanatory, but have various shades of meaning even when used by "experts" in the computer industry. Every attempt has been made to use them consistently in this report, and the following definitions are presented so that the reader will know exactly how these terms are used.

New-built shipments are expressed in millions of dollars, and are calculated on the basis of the manufacturer's list purchase price for the equipment. Since the bulk of computer equipment is shipped on a rental agreement, this figure does not represent immediate income to the manufacturer. Figures for new-built shipments represent IDC's best estimate of a manufacturer's factory production and include complete new systems, peripheral equipment or "add-on" shipments such as additional memory, and the added value of equipment that has been recycled through a manufacturing plant and upgraded. The figure does not include equipment merely reshipped from one customer to another, nor does it take into consideration old equipment that may be sent back by a customer.

Some computer manufacturers and industry analysts discuss new-net shipments. This is the value of computers and add-on equipment shipped during the year, less the value of equipment returned by the user and not reshipped by the manufacturer.

Installed value is represented in two different ways. One is the total value of equipment installed based on the original purchase price. The other is in terms of equivalent monthly rental value. This is the amount the customer would pay each month if the equipment were on rent from the manufacturer, and can be converted to installed value by multiplying it by the specific manufacturer's purchase-to-rent ratio. These ratios -- which represent the number of months a computer would have to be on rent before monthly payments equal the purchase price -- include charges for maintenance of the equipment. The ratios vary from manufacturer to manufacturer and from product to product within a given manufacturer's equipment line. Based on its analysis of typical system configurations, IDC uses the following ratios in its calculations:

Burroughs	48
Control Data	43
HIS: Honeywell base	45
GE base	44
IBM	45
NCR	48
RCA	45
Univac	44

In general, the lower a company's purchase-to-rent ratio, the more oriented it is toward outright sales rather than rental business.

Average system prices, in terms of monthly rental value, are calculated by IDC annually based on its Computer Installation Data Files. Since existing computer users often retain some of their original peripherals when installing a new mainframe, and since users typically add from 5% to 15% of value each year in add-on equipment, average system values for a given computer model tend to grow with time, and usually are not the same as a manufacturer's stated "typical" system value upon initial introduction.

The bulk of the detailed calculations in this report are based on what IDC calls general-purpose computers. In general, these machines are usually byte or character oriented (with the exception of large-scale scientific word-oriented computers), are normally programmed in a higher level language, such as COBOL or FORTRAN, and are usually used for many applications at each installation.

In estimating the number of these computers installed, IDC has attempted not to include those used by the computer manufacturers for sales promotion, program check-out, maintenance training, or other uses designed to directly support the sales or successful performance of the computer itself. The figures do include, however, all computers used for normal managerial, engineering, and manufacturing functions by the manufacturer, and its related data processing service bureaus and computer programming schools.

In contrast to general-purpose computers, there are other types of computers referred to by IDC as dedicated application computers that, although general purpose in central processor design, are usually small word (typically, 8, 12, 16, or 24 bits) oriented, and programmed either in machine language or FORTRAN. They are usually used for only one application at each installation and normally are purchased. This group includes all the so-called minicomputers (typically selling for less than $25,000) as well as certain larger computers and those designed for process control.

Several manufacturers also supply military and airborne computers, such as Univac 12XX series mil spec, and IBM's 4 Pi. IDC does not maintain details on these special-purpose computers, nor is their value discussed in this document.

IBM and several other manufacturers manufacture and maintain electrical accounting machines (EAM), including conventional punched-card equipment such as sorters, collators, and tabulators, however such figures are not included in user spending and manufacturer revenue data, but are not monitored by IDC.

USER SPENDING

As part of its annual research about the computer industry, IDC samples U.S. computer users each fall for an "early warning" snapshot of projected spending for the next year. Then, at yearend, a larger cross-section of the user population is polled to verify the early inputs and detect any changes after budgets are finalized.

The survey at yearend 1973 indicated that user budgets for equipment, services, and salaries for 1973 had hit the $20 billion level (Chart 101) and would increase an average of about 15% during 1974. The study was based on an analysis of EDP budgets at 600 U.S. sites in December, 1973 and combined with a long-range study of management attitudes at 50 key "Fortune 500" companies.

The distribution of spending on major budget items has shown only slight changes over recent years -- with the expected growth of emphasis on support hardware for communications and teleprocessing:

+ Salaries continue to eat up 35% of the average DP budget, similar to five years ago. Users are looking for fewer but more highly skilled specialists to develop and maintain their DP operations. On-line data entry from the source -- a possibility that helps make networking attractive -- is drawing salary dollars away from the traditional keypunch operator.

+ EDP systems also take 35% of the dollars and support hardware will account for another 11%. Users say they're willing to pay for the best equipment available -- but will also try to save money through long-term commitments to third-party leases and outright purchases. Users are looking for vendors who can meet their upgrade needs and be stable suppliers in the future.

+ Supplies, which will account for 6% to 7% of the average DP budget this year, as prices increase -- mainly because of rising paper costs -- and shortages cause occasional problems.

+ Services, including "total solutions," timesharing and keypunching, will account for another 10% of the bill when spending by "non-DP users is taken into account."

+ Custom and packaged software from outside vendors will consume just over 1% of 1974's DP dollars. Most of this goes to supplement in-house software development.

The bulk of mainframe spending is going for large systems -- following the trend toward centralization as users take advantage of the economies offered by big machines. By yearend 1974, many users will already be looking forward to the end of the 370 product marketing cycle and in increasing numbers will begin marking time until the next product round -- marked by so-called "FS" or the Future System IBM is expected to announce for deliveries by 1977.

U.S. COMPUTER USER SPENDING

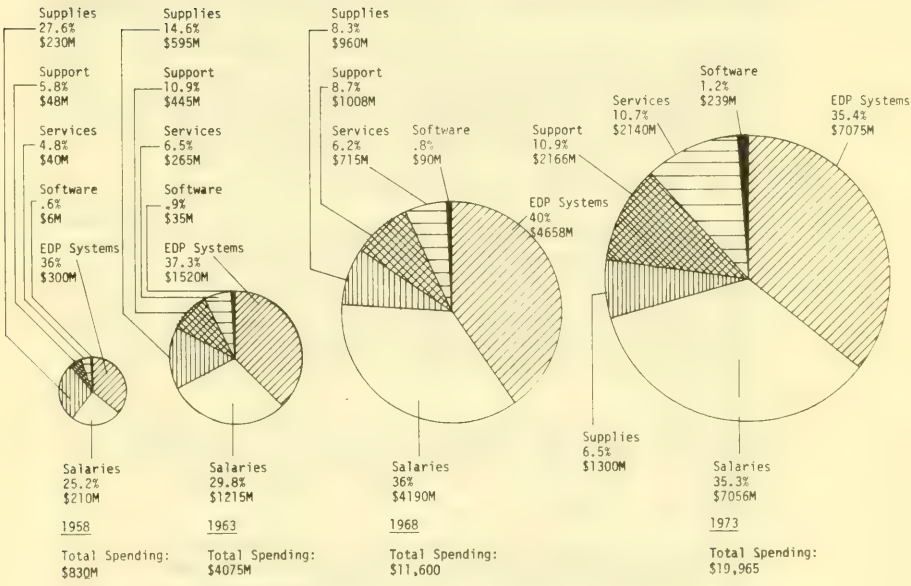


Table 101

MAINFRAME MANUFACTURERS

There are many ways of measuring market share -- by number of units versus dollar value, U.S. versus international markets, general-purpose versus dedicated application (mini) computers, etc. Table 102 is based on worldwide revenue of the current eight, U.S.-based computer system manufacturers (including the base of the former GE and RCA computer operations). The data is taken directly from published information, as noted, or derived from similar sources. Major observations for the 1969-1973 period:

+ IBM has held relatively stable, about 66-67% market share,

+ HIS has been in the 9-10% market share, losing slightly in 1973,

+ Univac has lost share slightly, from 9% (retroactively in 1969) to 7% today,

+ CDC has been in the 6-7% range, with relatively major gain in peripherals and services,

+ Burroughs has slowly but surely gained from 3.7% in 1969 to 5.4% today,

+ DEC has doubled its market share over the past five years from 1.3% to 2.5%,

+ NCR has climbed, but only from 1.6% to 2.2%,

+ Xerox dropped from a high of 1.5% in 1969 to a low of 0.7% in 1971, and came back to 0.9% in 1973.

TABLE 102

WORLDWIDE REVENUE GROWTH AND MARKET SHARE
U.S. BASED EDP SYSTEMS MANUFACTURERS

	1969		1970			1971			1972			1973		
	$M	% Share	% Δ	$M	% Share	% Δ	$M	% Share	% Δ	$M	% Share	% Δ	$M	% Share
IBM (a)	5,686	67.1	4.3	5,928	66.0	10.3	6,537	67.0	15.2	7,531	67.1	15.3	8,684	65.9
HIS	351	4.1	20.5	423	4.7	] 10.6	950	9.7	11.7	1,061	9.5	10.9	1,177	8.9
GE	412	4.9	5.8	436	4.9	]								
Univac (b)	526	6.2	9.1	574	6.4	6.3	610	6.3	11.8	682	] 7.3	] 13.6	928	7.0
RCA	239	2.8	5.4	252	2.8	(20.6)	200	2.0	(32.5)	135	]	]		
CDC	571	6.7	(5.4)	540	6.0	5.9	571	5.9	17.5	671	6.0	39.4	936	7.1
Burr (c)	317	3.7	28.0	406	4.5	9.8	446	4.6	27.5	569	5.1	25.9	716	5.4
DEC (d)	113	1.3	25.7	142	1.6	14.1	162	1.7	33.3	216	1.9	53.7	332	2.5
NCR (e)	134	1.6	43.8	192	2.1	11.5	214	2.2	17.3	251	2.2	17.5	295	2.2
Xerox	125	1.5	(33.6)	83	0.9	(21.7)	65	0.7	53.8	100(f)	0.9	15.0	115	0.9
TOTALS	8,474	100.0	5.9	8,976	100.0	8.7	9,755	100.0	15.0	11,216	100.0	17.5	13,183	100.0
Non-IBM	2,788	32.9	9.3	3,048	34.0	5.6	3,218	33.0	14.5	3,685	32.9	22.1	4,499	34.1

a. Data Processing Group, including EAM, etc.
b. FY following March 31, Including Univac Division, excluding Guidance & Control, including RCA since 1/72 and ISS - 7/73
c. Small Computers and Business Minis + Medium and Large Computer Systems, excluding Small Application Machines
d. FY June 30 figures converted to calendar year 12/31 for compatibility
e. EDP systems only
f. including $12M - Diablo acquisition - 4/72

Another way of looking at the computer marketplace is to measure the value of equipment installed. (For this purpose, equipment on rent from the manufacturer is converted to equivalent purchase value by the method described elsewhere in this submission.) Since IDC's basic research is based on user descriptions of equipment installed, this data represents IDC's most reliable measure of the computer equipment marketplace.

Table 103 gives a summary of the worldwide installed base for U.S.-based mainframe manufacturers in its U.S., International, and Worldwide components. More details, plus comparable data for 1972, is contained in Tables 104, 105, and 106.

It should be noted that, in these tables, IDC has summarized the market position:

+ for U.S.-based manufacturers only;

+ for general-purpose (Group A) and dedicated application (Group B) type computers;

+ the tables include percent rate of growth of installed base (after taking into account shipments of new equipment, retirements, etc.) and percent market share.

In the long run, a computer manufacturer's revenue closely parallels the growth and size of its installed base. During short time intervals, there can be significant variations as large numbers of purchased computers are shipped (disproportionately increasing revenues).

In Tables 107 and 108, the general-purpose portion of each mainframer's base has been summarized by rent/third-party lease/user-owned. At the bottom of each of these tables the change from 1972 is shown.

TABLE 103

12/73 WORLDWIDE INSTALLED BASE
U.S.-BASED MANUFACTURERS - GROUP A COMPUTERS

	U.S.: # CPU	Avg. $K	$M Value	% Total	Inter.: # CPU	Avg. $K	$M Value	% Total	Worldwide: # CPU	Avg. $K	$M Value	% Total
IBM (*)	40,931	458	18,731	68.6	26,442	436	11,527	67.3	67,373	449	30,258	68.1
HIS	5,899	437	2,579	9.4	8,075	252	2,036	11.9	13,974	330	4,615	10.4
Univac	5,921	372	2,205	8.1	3,892	343	1,378	7.8	9,813	365	3,583	8.1
Burroughs	2,801	507	1,421	5.2	1,576	522	823	4.8	4,377	513	2,244	5.0
CDC	513	1,897	973	3.6	416	1,779	740	4.3	929	1,843	1,713	3.8
NCR	4,441	166	737	2.7	3,292	142	468	2.7	7,733	156	1,205	2.7
Others	1,739	377	656	2.4	848	239	203	1.2	2,587	332	859	1.9
TOTALS	62,245	439	27,302	100.0	44,541	386	17,175	100.0	106,786	416	44,477	99.9

* inc. est. $1.325M - PCM in U.S. and $295M in International

TABLE 104

U.S. - MARKET SHARE
($ Million)

	12/72 Inst. Base		% Total		% Δ	12/73 Inst. Base		% Total
IBM - Mfr'd	15,734		59.3		10.6	17,406		59.0
- PCM	1,015		3.8		30.5	1,325		4.4
- Sub (A)	16,749				11.8	18,731		
- (B)	183				38.2	253		
HIS - (A)	2,366	]	9.8	]		2,578	]	9.6
- (B)	260	]		]	9.6	301	]	
Univac	1,365				5.5	1,440		
RCA	853				(10.3)	765		
Sub	2,218		8.3		(0.6)	2,205	]	7.4
(B) (EMR)						23	]	
Burroughs	1,262		4.7		12.6	1,421		4.7
CDC - (A)	935	]	4.3		4.1	973	]	4.0
- (B)	221	]			1.8	225	]	
NCR	670		2.5		10.0	737		2.5
DEC - (A)	105	]			27.6	134	]	
- (B)	399	]	1.9		39.1	555	]	2.3
Xerox - (A)	342	]	1.7		14	390	]	1.8
- (B)	127	]			8.7	138	]	
Others - (A)	91	]			45	132	]	
- (B)	903	]	3.7		26.9	1,146	]	4.3
Subtotal - (A)	24,738		92.2		10.4	27,301		91.2
- (B)	2,093		7.8		26.2	2,641		8.8
TOTALS	26,831		100.0		11.6	29,942		100.0

TABLE 105

INTERNATIONAL - MARKET SHARE (*)
($ Million)

	12/72 Inst. Base	% Total	% Δ	12/73 Inst. Base	% Total	Inter.-% W.W. $ Total
IBM - Mfr'd	10,023	64.7	12.1	11,232	63.4	39
- PCM	218	1.4	35.3	295	1.6	18
- Sub (A)	10,241		12.6	11,527		
- (B)	107		17.8	126		
HIS - (A)	1,800]	11.9	] 14.1	2,036]	11.8	43
- (B)	67]		]	95]		
Univac/RCA	1,167	7.4	18.0	1,378]	7.7	38
(B) (EMR)				12]		
Burroughs	679	4.3	21.0	823	4.6	37
CDC - (A)	647]	4.5	14.4	740]	4.4	40
- (B)	56]		3.6	58]		
NCR	412	2.6	13.6	468	2.6	39
DEC - (A)	48]		10.4	53]		
- (B)	136]	1.2	63.2	222]	1.5	29
Xerox - (A)	70]	0.6	16	81]	0.6	18
- (B)	30]		15	35]		
Others - (A)	45]		50	68]		34
- (B)	171]	1.4	54.4	264]	1.8	19
Subtotal - (A)	15,109	96.4	13.7	17,174	95.5	39
- (B)	567	3.6	43.2	812	4.5	24
TOTALS	15,676	100.0	14.7	17,986	100.0	38

* U.S.-based manufacturers only

TABLE 106

WORLDWIDE - MARKET SHARE (*)
($ Million)

	12/72 Inst. Base	% Total	% Δ	12/73 Inst. Base	% Total
IBM - Mfr'd	25,757	61.3	11.1	28,638	60.5
- PCM	1,233	2.9	31.4	1,620	3.4
- Sub (A)	26,990		12.1	30,258	
- (B)	290		30.7	379	
HIS - (A)	4,166]	10.6	] 11.5	4,614]	10.5
- (B)	327]		]	396]	
Univac/RCA	3,385	8.0	] 6.9	3,583]	7.5
EMR (B)			]	35]	
Burroughs	1,941	4.6	15.6	2,244	4.7
CDC - (A)	1,582]	4.4	] 7.4	1,713]	4.2
- (B)	277]		]	283]	
NCR	1,082	2.5	11.4	1,205	2.5
DEC - (A)	153]		22.2	187]	
- (B)	535]	1.6	45.2	777]	2.0
Xerox - (A)	412]	1.3	] 13.2	471]	1.3
- (B)	157]		]	173]	
Others - (A)	136]		47.1	200]	
- (B)	1,074]	2.8	31.3	1,410]	3.4
Subtotal - (A)	39,847	93.7	11.6	44,475	92.8
- (B)	2,660	6.3	29.8	3,453	7.2
TOTAL	42,507	100.0	12.8	47,928	100.0

* U.S.-based manufacturers only

TABLE 107

MARKET STRUCTURE - RENT/LEASE/OWNED, U.S.
12/73 G.P. INSTALLED BASE

	Total # CPU	Total $M Value	Rent: # CPU	Rent: $M Value	Rent: % Total $	Lease: # CPU	Lease: $M Value	Lease: % Total $	Owned: # CPU	Owned: $M Value	Owned: % Total $
IBM	40,931	18,731	28,112	8,356	45	5,498	4,458	24	7,321	5,917	31
HIS - G	1,653	1,006	689	296	30	355	163	16	609	547	54
- H	4,246	1,573	2,443	728	46	591	260	17	1,212	585	37
- Sub	5,899	2,579	3,132	1,024	40	946	423	16	1,821	1,132	44
Univac	4,960	1,441	1,610	377	26	871	268	19	2,479	796	55
RCA	961	755	390	319	42	111	91	12	460	345	46
Sub	5,921	2,196	2,000	696	32	982	359	16	2,939	1,141	52
Burroughs	2,801	1,421	1,597	767	54	342	215	15	862	439	31
CDC	513	973	108	133	14	80	168	17	325	672	69
NCR	4,441	723	2,886	503	69	617	64	9	937	156	22
Others	1,739	656	683	147	22	101	38	6	955	471	72
TOTALS	62,245	27,279	38,518	11,626	42.6	8,566	5,725	21.0	15,160	9,928	36.4
% Total (#)			61.9			13.8			24.3		
vs. 12/72			66.2		49.9	12.3		18.8	21.4		31.3

TABLE 108

MARKET STRUCTURE - RENT/LEASE/OWNED, INTERNATIONAL (*)
12/73 G.P. INSTALLED BASE

	Total # CPU	Total $M Value	Rent: # CPU	Rent: $M Value	Rent: % Total $	Lease: # CPU	Lease: $M Value	Lease: % Total $	Owned: # CPU	Owned: $M Value	Owned: % Total $
IBM	26,442	11,530	21,504	8,174	71	1,201	900	8	3,737	2,456	21
HIS - G	6,181	1,309	3,947	696	53	490	123	9	1,744	490	38
- H	1,894	691	1,209	392	57	120	45	6	565	254	37
- Sub	8,075	2,000	5,156	1,088	54	610	168	8	2,309	744	37
Univac/RCA	3,892	1,378	1,802	555	40	219	89	7	1,871	734	53
Burroughs	1,576	823	1,075	511	62	62	28	3	439	284	35
CDC	416	740	172	312	42	7	10	1	237	418	57
NCR	3,292	458	938	185	40	262	30	7	2,092	243	53
Others	848	203	257	47	23	84	21	10	507	135	67
TOTALS	44,541	17,132	30,904	10,872	63.5	2,445	1,246	7.3	11,192	5,014	29.2
% Total (#)			69.4			5.5			25.1		
vs. 12/72			68.5		65.1	5.8		7.0	25.7		27.9

* U.S.-based manufacturers only

TABLE 109

COMPUTER SYSTEMS - CURRENTLY MARKETED (5/8/74)
(GENERAL-PURPOSE, GROUP A ONLY)

Average System Monthly Rental	IBM	HIS	Univac	BURR	CDC	NCR
$ 1,250				705/711		
	3/6	61/58(E)				C-50
		61/60(E)		1712		
2,500	3/10		9200	1714		
		62/40(E)				C-101
	3/15	62/60				
5,000			9300	1726		
	115	64/20		1728		C-200
				2700		
10,000	125					C-251
		64/40(E)	9400			
	135		90/60			
20,000			418-III	3700		C-300
	145	66/20	90/70	4700		
		66/40		5700		
40,000			1106		C-172(s)	
	158	66/60		6700	C-173(s)	
					C-174(s)	
80,000		66/80	1110		C-175(s)	
	168			7700	C-76	
		68/80				
160,000						
	195					

E: available in Europe only
s: inc. software priced separately

Currently Marketed Computer Systems

Table 109 lists those computer systems actively marketed and currently being manufactured by the general-purpose manufacturers. Observations:

+ IBM covers the entire spectrum, with all models relatively new.

+ HIS has been updated to reflect the recent Series 60 product announcements, they similarly cover the entire spectrum, although there is some gap in the U.S. marketplace parallel to the IBM 370/125 and 135.

+ Univac covers most of the price ranges, and with the recent introduct of the 90/30, the company seems to be taking an up-to-date approach for replacing models dating back to 1967.

+ Burroughs covers the entire price range.

+ CDC, even with the recently announced 17X series, still concentrates on the over $40,000 monthly rental range. The small and medium 31/32/3300 is now out of new-built production.

+ NCR, with its five models of the Century series, cover_ the five small to medium price ranges.

Marketplace Performance of Systems Manufacturers

The chart on page 25 shows in a general way the result of past and expected future shipment activity by U.S. computer systems manufacturers on a worldwide basis. (Dedicated application and minicomputers, which account for only a small percentage of the value of computers, are not included.) The chart describes user demand as interpreted by IDC from several extensive surveys during the past two years. Allowance is made for IBM's internal assessments prepared about the time System/370 models were first being delivered. Shipments should increase 6% to the $9 billion level this year, then remain fairly flat until deliveries of IBM's FS (Future System, IBM's next family of computers expected to be announced for 1977 delivery). As retirements hold level of decline during the next couple of years, about $5 billion of each year's shipments should be added to the installed base.

In the U.S., only 43% of the computers (by value) are currently on rent (see page 20), down from 50% last year and 55% the year before. IDC surveys indicate that more and more users plan to purchase (or would like to arrange a third-party lease) and the extent to which this trend continues will determine the structure of the computer industry. One argument is this merely reflects better management and commitment to long-range plans on the part of users; IDC's extensive research supports this view. The other possibility to be considered, of course, is that subtle efforts on the part of IBM (and other mainframers?) are designed to foster this user attitude so that, for the late 1970s, a truly new generation of hardware can be shipped in vast quantities. In any event, the mainframe manufacturers control less equipment (as a percentage) than at any time in recent history.

The above situation -- in addition to the growing sophistication of computer networks and the commitment of users to incorporate key aspects of their business under computer management -- points to what is probably the strongest trend in computer acquisition considerations today. The operating system, or control software, is becoming more important to users than the actual hardware selected for use in a particular sized installation.

Some perspective on the past success of each of the major computer system manufacturers can be gained from Table 111, which shows the build-up of the U.S. installed base of computers over the past 15 years. This table, in addition, provides a striking example of the proliferation of minicomputers. The number of general-purpose computers grew by a factor of 1.5 -- from just over 40,000 to just over 60,000. During the same five-year period, however, some 70,000 minicomputers worth about $2 billion were installed in the U.S. As a result, these small computers now account for one-third of all the computers installed, and the trend will continue. By 1978, IDC estimates that general-purpose computers will account for barely over 20% of the U.S. computer population. These are and increasingly will be large and expensive systems, however. The <u>value</u> of general-purpose computers installed -- which dropped from 99+% of the total five years ago to just over 90% today -- will still represent 80+% of the value installed in 1978. Tables 112, 113, and 114 give IDC's estimates of past computer activity by U.S.-based manufacturers and forecasts for the next five years.

TABLE 110

GENERAL-PURPOSE COMPUTER MARKETPLACE -- WORLDWIDE FOR U.S.-BASED MANUFACTURERS
(Estimates and Projections Copyright 1974 by International Data Corporation)

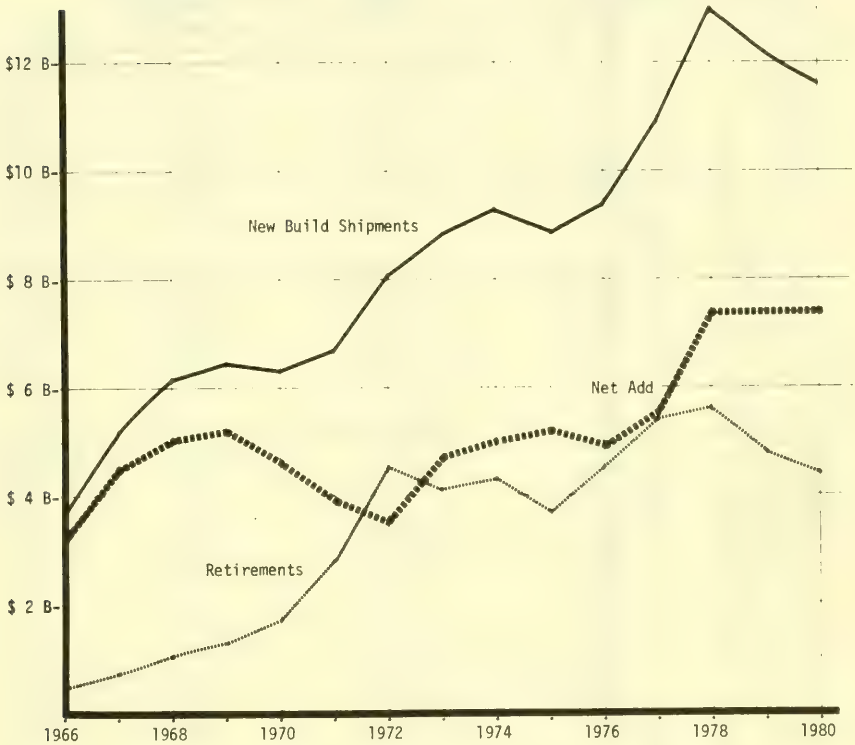


TABLE 111

U.S. INSTALLED BASE - SHARE BY MANUFACTURER
(Percentages based on Number and $ Million Value of All Computers)

	1958		1963		1968		1973	
	%-Number	%-Value	%-Number	%-Value	%-Number	%-Value	%-Number	%-Value
IBM	76.2	73.9	66.3	76.3	58.5	64.5	31.3	63.4
Honeywell	0.2	0.7	0.6	1.7	6.0	7.2		
GE	-		1.1	1.5	2.9	4.0		
HIS							7.1	9.6
Univac	3.8	11.4	7.2	6.3	8.5	6.3	4.3	7.4
RCA	1.0	1.8	2.3	2.9	2.5	4.0		
Burroughs	3.9	3.6	2.5	2.5	2.8	3.1	2.0	4.7
CDC	-	-	4.4	3.5	3.6	5.7	1.6	4.0
NCR	-	-	3.4	1.7	7.3	3.2	3.2	2.5
DEC	-	-	-	-	3.7	0.5	16.0	2.3
SDS/Xerox	-	-	0.7	0.2	2.3	1.2	1.1	1.8
Others	14.9	8.6	11.5	3.4	1.9	0.3	33.3	4.3
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
N =	2,250	$ 820	16,900	$5,400	46,500	16,600	133,250	29,900

TABLE 112

WORLDWIDE COMPUTER MARKET
(U.S.-BASED MANUFACTURERS)

	Number Systems Shipped	Cumulative Number In Use	$ Million Value Shipped	$ Billion Value In Use
		WORLDWIDE		
1966	10,500	44,300	$ 3,825	$ 13.7
1967	18,450	55,900	5,420	18.4
1968	17,600	71,400	6,422	23.7
1969	19,100	87,000	6,805	29.3
1970	23,100	105,800	6,715	34.2
1971	27,800	129,200	7,077	38.5
1972	40,900	160,300	8,535	42.5
1973	55,350	204,800	$ 9,575	$ 47.9
1974	69,500	266,000	10,385	54.0
1975	89,500	348,500	10,330	60.6
1976	117,000	457,500	11,220	67.3
1977	147,000	595,000	13,130	74.8
1978	170,000	753,000	15,670	84.7
		UNITED STATES		
1966	7,000	31,100	$ 2,690	$ 9.9
1967	12,000	37,000	3,775	13.1
1968	11,000	46,500	4,367	16.6
1969	12,700	56,800	4,430	20.3
1970	14,600	68,300	3,920	23.0
1971	17,600	83,200	4,177	25.1
1972	27,400	104,000	5,395	26.8
1973	38,700	133,250	$ 5,945	$ 29.9
1974	47,300	171,500	6,350	33.5
1975	59,500	222,500	5,775	37.2
1976	78,000	290,500	6,120	40.9
1977	100,000	376,000	7,375	45.0
1978	112,000	481,000	8,720	50.4
		INTERNATIONAL		
1966	3,500	13,200	$ 1,135	$ 3.8
1967	6,450	18,900	1,645	5.3
1968	6,600	24,900	2,055	7.1
1969	6,400	30,200	2,375	9.0
1970	8,500	37,500	2,795	11.2
1971	10,200	46,000	2,900	13.4
1972	13,500	56,300	3,140	15.7
1973	16,650	71,550	$ 3,630	$ 18.0
1974	22,200	94,500	4,035	20.5
1975	30,000	126,000	4,555	23.4
1976	39,000	167,000	5,100	26.4
1977	47,000	219,000	5,755	29.8
1978	58,000	272,000	6,950	34.3

TABLE 113

GENERAL PURPOSE COMPUTER MARKET (GROUP A)
(U.S.-BASED MANUFACTURERS)

	Number Systems Shipped	Cumulative Number In Use	$ Million Value Shipped	$ Billion Value In Use
		WORLDWIDE		
1966	9,000	39,100	$ 3,700	$ 13.1
1967	15,700	48,000	5,200	17.6
1968	13,000	59,000	6,150	22.6
1969	11,000	66,700	6,450	27.8
1970	12,000	74,800	6,300	32.4
1971	14,300	85,200	6,700	36.3
1972	18,300	94,800	8,035	39.8
1973	21,450	106,800	$ 8,805	$ 44.5
1974	19,500	120,000	9,300	49.5
1975	18,500	133,500	8,900	54.7
1976	21,000	148,500	9,400	59.6
1977	26,000	167,000	10,900	65.1
1978	26,000	183,000	13,000	72.5
		UNITED STATES		
1966	6,000	27,100	$ 2,600	$ 9.4
1967	10,000	31,000	3,600	12.4
1968	7,400	37,000	4,150	15.7
1969	6,000	40,700	4,150	19.1
1970	5,700	43,800	3,600	21.5
1971	7,600	49,200	3,900	23.3
1972	10,700	54,000	5,035	24.7
1973	14,000	62,250	$ 5,405	$ 27.3
1974	11,300	70,000	5,600	30.1
1975	9,500	77,000	4,800	32.9
1976	11,000	85,000	4,900	35.4
1977	16,000	97,000	5,900	38.2
1978	14,000	106,000	7,000	42.0
		INTERNATIONAL		
1966	3,000	12,000	$ 1,100	$ 3.7
1967	5,700	17,000	1,600	5.2
1968	5,600	22,000	2,000	6.9
1969	5,000	26,000	2,300	8.7
1970	6,300	31,000	2,700	10.9
1971	6,700	36,000	2,800	13.0
1972	7,600	40,800	3,000	15.1
1973	7,450	44,550	$ 3,400	$ 17.2
1974	8,200	50,000	3,700	19.4
1975	9,000	56,500	4,100	21.8
1976	10,000	63,500	4,500	24.2
1977	10,000	70,000	5,000	26.9
1978	12,000	77,000	6,000	30.5

TABLE 114

DEDICATED APPLICATION COMPUTER MARKET (GROUP B)
(U.S.-BASED MANUFACTURERS)

	Number Systems Shipped	Cumulative Number In Use	$ Million Value Shipped	$ Million Value In Use
		WORLDWIDE		
1966	1,500	5,200	$ 125	$ 587
1967	2,750	7,900	220	807
1968	4,600	12,400	272	1,079
1969	8,100	20,300	355	1,433
1970	11,100	31,000	415	1,845
1971	13,500	44,000	377	2,216
1972	22,600	65,500	500	2,703
1973	33,900	98,000	$ 770	$ 3,453
1974	50,000	146,000	1,085	4,503
1975	71,000	215,000	1,430	5,878
1976	96,000	309,000	1,820	7,608
1977	121,000	428,000	2,230	9,703
1978	144,000	570,000	2,670	12,173
		UNITED STATES		
1966	1,000	4,000	$ 90	$ 506
1967	2,000	6,000	175	681
1968	3,600	9,500	217	898
1969	6,700	16,100	280	1,177
1970	8,900	24,500	320	1,494
1971	10,000	34,000	277	1,766
1972	16,700	50,000	360	2,116
1973	24,700	71,000	$ 540	$ 2,641
1974	36,000	101,500	750	3,366
1975	50,000	145,500	975	4,301
1976	67,000	205,500	1,220	5,456
1977	84,000	279,000	1,475	6,836
1978	98,000	375,000	1,720	8,421
		INTERNATIONAL		
1966	500	1,200	$ 35	$ 81
1967	750	1,900	45	126
1968	1,000	2,900	55	181
1969	1,400	4,200	75	256
1970	2,200	6,500	95	351
1971	3,500	10,000	100	450
1972	5,900	15,500	140	587
1973	9,200	27,000	$ 230	$ 812
1974	14,000	44,500	335	1,137
1975	21,000	69,500	455	1,577
1976	29,000	103,500	600	2,152
1977	37,000	149,000	755	2,867
1978	46,000	195,000	950	3,752

CHART 115

U.S. COMPUTER POPULATION

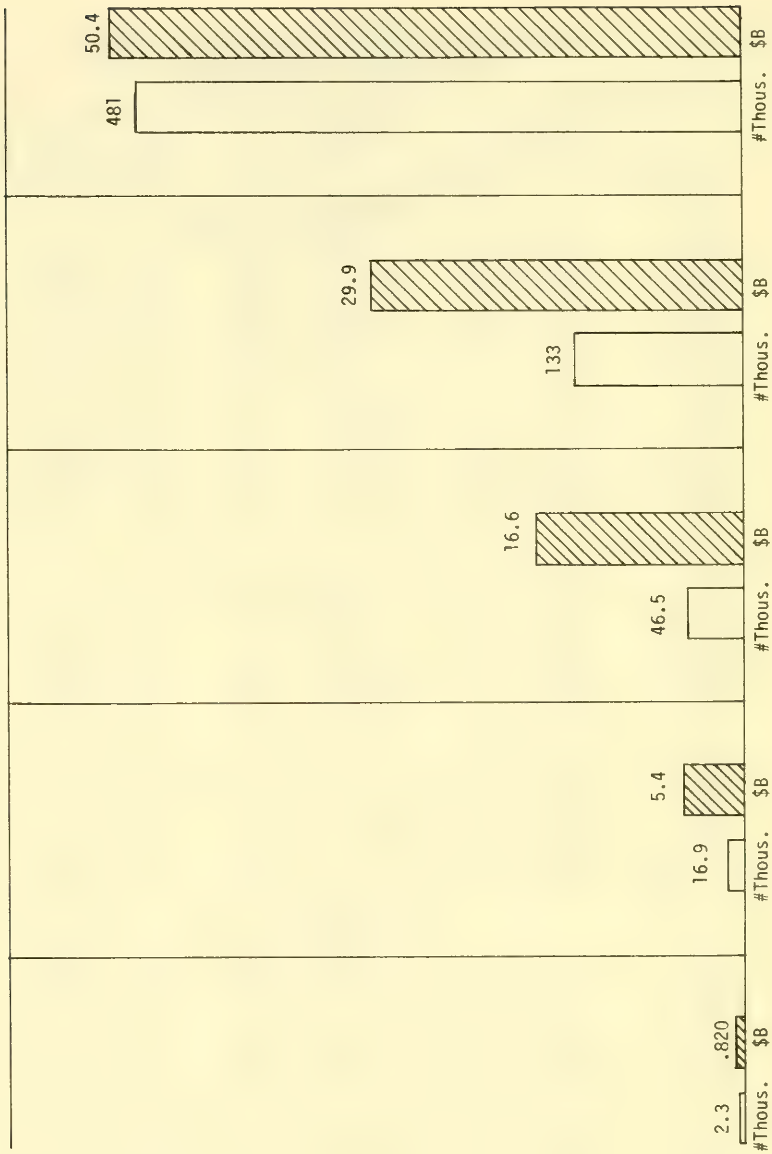
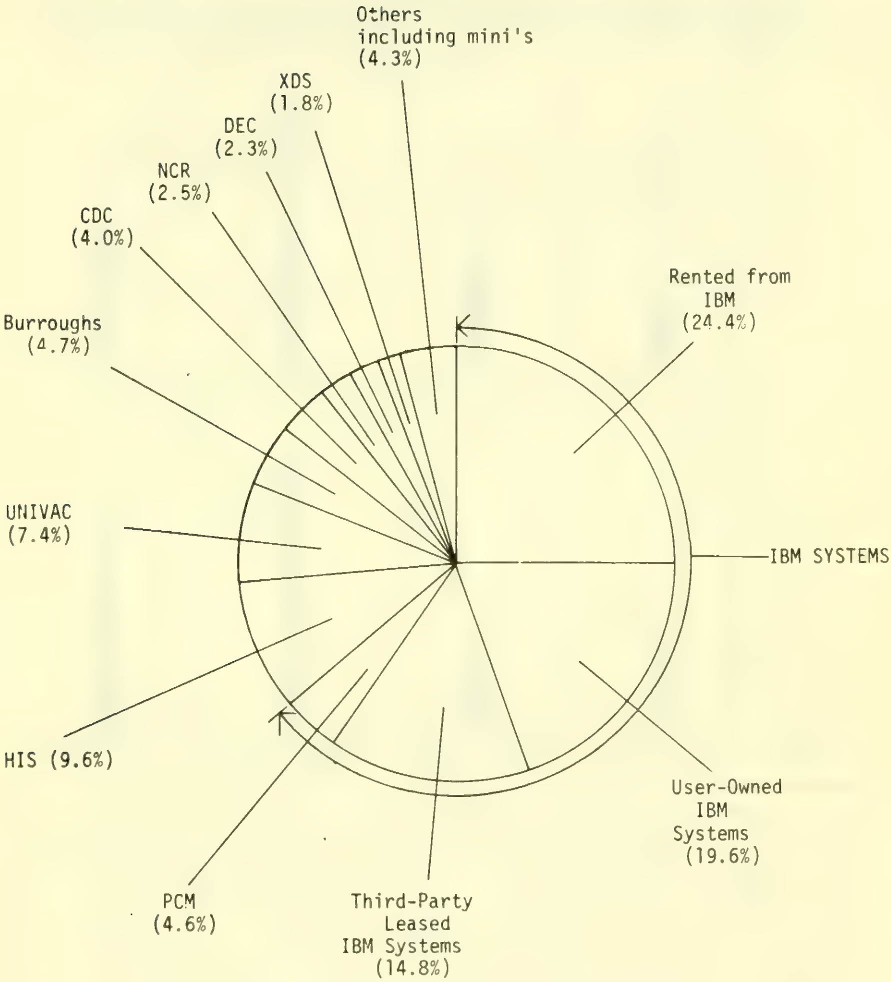


CHART 116

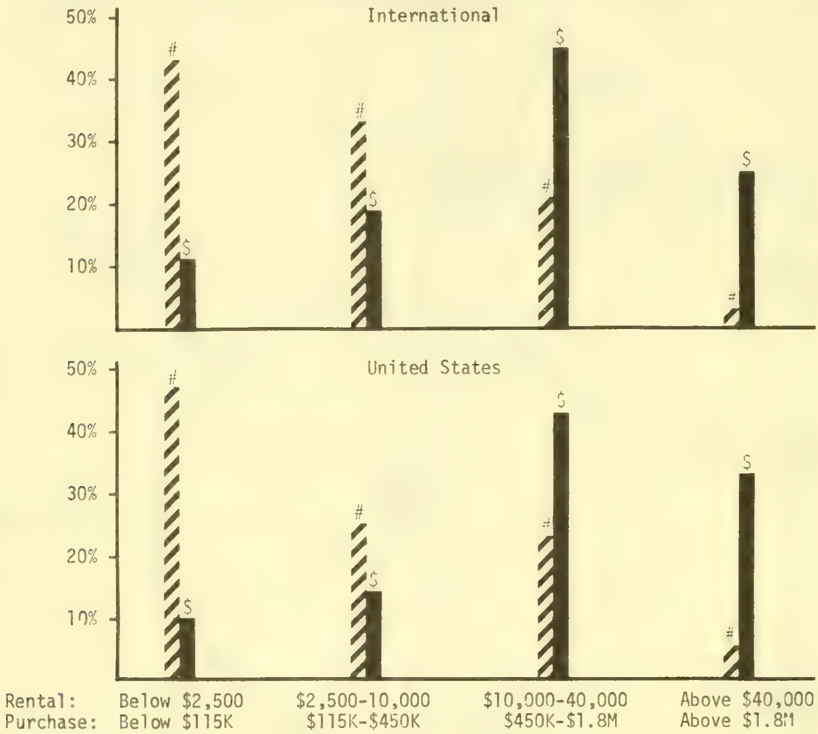


U.S. INSTALLED BASE AT YEAR-END 1973

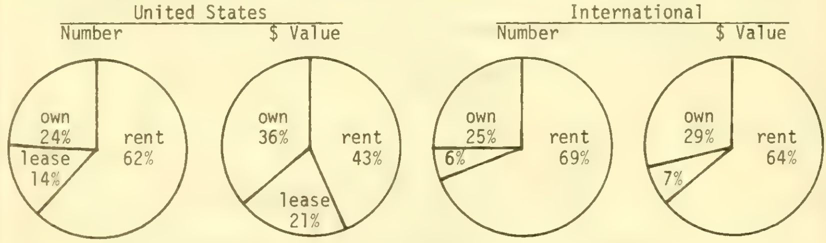
$30 BILLION

CHART 117

PRICE CLASS DISTRIBUTION OF GENERAL-PURPOSE COMPUTERS INSTALLED, YEAREND 1973
(U.S.-Based Manufacturers; Copyright 1974 by International Data Corporation)



DISTRIBUTION OF GENERAL-PURPOSE COMPUTERS BY ACQUISITION METHOD
(Installed, Yearend 1973; Copyright 1974 by International Data Corporation)



The general information presented above provides a background with which to view the status of each of the major manufacturers of computer systems hardware. Here is a capsule of IDC's analysis as the computer industry enters a three-year period of relatively stable shipment levels and net addition to installed base:

IBM -- The big question about IBM, and for that matter about the entire EDP industry, is in the courts and for that matter the Halls of Congress. The Telex verdict is being appealed (with a decision from Denver expected any day now); the Justice Department case is still set for trial in October; this Subcommittee's efforts may lead to a new set of ground rules under which the computer industry will have to operate. But none of these outside factors has had much effect in the computer marketplace to date, and IDC for this submission simply recognizes the monumental importance of whatever happens.

The foreseeable business future looks bright for IBM. Production of 370 will probably peak during 1974, and a new entry-level machine below the System/3 likely will be announced. Probably of more significance this year or next will be the introduction of "Q" -- the new operating system (from IBM) that is supposed to meet "all" functional requirements for at least the next ten years. It will obviously be designed to smooth the movement from 370 to FS, and likely will offer users much more flexibility with teleprocessing/large data base networks.

Internationally, IBM is probably better equipped than the other mainframers -- than any other U.S. corporation, in fact -- to cope with fluctuating currencies, individual economic problems, the fuel crisis, inflation, and the like. It is so widespread, so established in major countries of the world, that one of the major challenges facing IBM is convincing nationalistic-minded governments that what's good for IBM is good for the individual country. There is growing pressure for at least the major World Trade companies to offer some local ownership.

HIS -- Honeywell has done an effective job in managing the merger of GE's computer interests in 1970. The 6000 series, for example, has proved to be more attractive to customers than even HIS management could have expected, and has accounted for considerable new business. Its new product line, announced in April, is based on the extensive software developed with the 6000 and has been introduced in such a way as to minimize the impact of the existing HIS installed base. If customer acceptance is as good as it has been for the philosophy of computing (originally developed by GE) demonstrated in the 6000, the company should be fairly well positioned in the marketplace.

Univac - In retrospect, Univac's 1972 acquisition of RCA's computer base has been much more successful than was expected. Loyalty from these users is measured by IDC as continuing at the 70%-to-80% level. And at the upper end of its product line, Univac's 1100 series -- especially the low-end 1106 -- is quite successful in teleprocessing and data base operations. The small end of the 9000 series is entering obsolescence, so the recent announcement of the 90/30 should compete with System/3 as well as offer growth potential for 9200 and 9300 users. It spans a much broader range than most prior single systems. On other fronts, Univac had broadened its industry stance via acquisition -- with dedicated application computers from EMR, disk file business from Dataproducts, peripherals from ISS, shared processors from Pertec.

Burroughs -- With perhaps the most complete full-line offering outside IBM, Burroughs has taken advantage of its established MCP operating system and continues to meet user needs for teleprocessing and data base operations. The 1700 is about the only computer making any inroads on the IBM installed base. Shipments of the 700 series are estimated to be at about the midpoint of the generation cycle, so Burroughs seems to be in excellent position for the next year or two, at least. Its customers remain loyal, putting up with occasional startup problems because they like the results they eventually get from Burroughs' offerings.

NCR -- Under new management and finally showing a profit in its computer operations, NCR is succeeding under a strategy that it used defensively: NCR needs computers . . . to support the business activity it excels at. Its new 299 electronic bookkeeping machine -- and the 399 -- should appeal widely for sub-entry-level computer and terminal business. NCR is also moving strongly in the autotransaction marketplace (page). On the computer front, the price/performance improved Century 101 and 251 -- plus the 300 -- seem to offer customers adequate upgrade paths until the joint CPU development program with CDC is announced.

CDC -- Recently, the "maker of the world's most powerful computers" transformed established product designs into integrated circuits and called it Cyber 170, introduced a Network Operating System, and completely unbundled software. This should probably more than supply customer needs until the series being developed with NCR is ready. For all its clout with big number crunchers, however, CDC is one of the most diversified suppliers in the information processing industry. Following last year's acquisition of Service Bureau Corp., services now account for about one-fourth of CDC's computer-related revenues; also, it is the largest supplier of IBM plug-compatible peripherals and has a thriving OEM business in the U.S. but especially abroad. Britain's International Computers Ltd. should shortly formalize its full partnership in Computer Peripherals Inc., the manufacturing company owned jointly by CDC and NCR.

USER ACQUISITION OF COMPUTERS

As mentioned in preceding sections of this submission, users today have a variety of methods by which they can acquire computers or their use.

+ Computer systems can be purchased outright from the manufacturer, with maintenance contracted for either from the manufacturer or from an independent vendor. In some cases, manufacturers offer term-payment plans in connection with purchases.

+ Equipment can be rented from the manufacturer, usually with a 90-day cancellation provision in the contract. This was an extremely popular acquisition method in the early days of computer use because customers feared they would be victims of obsolescence. The method is still the most popular acquisition method -- it offers a convenient "pay-as-you-go" approach -- but has been waning in popularity some as forward planning and vendor confidence has assured users they will keep equipment for a lengthening number of years. Most of the manufacturers, in fact, offer term leases that give users lower monthly rates -- but can have stiff cancellation penalties. Maintenance is provided by the manufacturer.

+ Computers -- or portions of computer systems, for that matter -- can be acquired from a third-party leasing company. This acquisition "invention" of the late 1960s involves an organization other than the user or the supplier taking title to a computer (sometimes buying it outright, sometimes even using the manufacturer's time-payment plan) and leasing it to the user at rates below those offered by the supplier. The viability of this approach, naturally, is based on the lessor's belief that a user will keep the equipment long enough to pay for it and more, or that a second (and third) user can be found to eventually provide a profitable payback for a given computer system. Maintenance can be acquired from the equipment manufacturer or an independent.

+ And as will be discussed in another section of this submission, the user can acquire the computer power he needs -- or provide for "peak load" power -- by using a computer service company or purchasing spare time (usually late at night) from another user. This is also the provision users have "in reserve" for the event of catastrophic failure of

some sort. Recently, in fact, users have been searching out and arranging for just such backup because they are running applications that must continue with a minimum of downtime. Most manufacturers can also supply a certain amount of backup in major metropolitan areas.

The effect of customer decisions about acquisition -- illustrated below for IBM -- presents an interesting phenomenon. Although user-owned or third-party leased systems (some of which, to further confuse the issue, are equipped with plug-compatible peripherals manufactured by still another company called a PCM for plug-compatible manufacturer) were designed and manufactured by one company, they are for the most part not so much under that manufacturer's "control." Most users today still rely on the original systems manufacturer to supply software improvements, but they are under no obligation to do so. There is nothing to prevent users from doing whatever they desire with a system once title passes away from the manufacturer. In any event, only 43% of computer systems in the U.S. today (by value) are on rent; the figure for IBM is an even lower 38.6%.

Third-Party Leasing

The concept of third-party leasing was introduced to the computer industry during the late 1960s, along with the heyday of the IBM System/360. Initially, it looked as if almost anyone with financial backing (or a good-sounding prospectus for Wall Streeters) and a book of order blanks could jump aboard the 360 roller coaster. Not that the risks weren't clear even then -- prospectuses bristled with warnings to investors that the fate of the leasing business turned on the whims of IBM -- but the potential profits seemed enough to draw legions of backers. About 20% of IBM's U.S. production of System/360s was grabbed up:

Today the game is continuing, but with an altered field of players and a new set of rules. Many 360 lessors beat a retreat when the higher-priced 370s were introduced. Some were foundering in red ink and couldn't raise capital to finance new portfolios; some took one look at the new family and decided it was merely an interim offering anyway; some decided to try other lines of business. But a few of the survivors, notably Itel and Leasco, plunged ahead -- and quite a few large financial institutions have entered the field.

Far more conservative accounting, financing and marketing practices are the hallmarks of the transformed computer leasing industry:

+ Short-term third-party leases are a thing of the past. Most users must commit themselves for at least five years to win significant cost advantages on 370s; during 1974 many lessors will stop writing even five-year operating leases and deal only in full-payout packages.

Lessor	\$ Value of 360 Portfolio--U.S. (\$M Original IBM Purchase Price)
Greyhound Computer Corporation	\$ 295
DPF Incorporated	225
Itel Corporation	215
Boothe Computer Corporation	205
Randolph Computer (First National Bank of Boston)	175
Diebold Computer Leasing	170
Rockwood Computer Corporation	155
Reliance Group (Leasco)	150
Computer Leasing Company (Wyly)	105
Granite Computer Leasing	100
National Computer Rental	90
Dearborn-Storm Corporation (original owner)	80
Talcott Computer Leasing	60
Others (including full-payout leasing by banks)	715
TOTAL	\$2,740

+ Lessors are depreciating 370 equipment over an expected useful life-span of eight years or so instead of the unrealistic ten to twelve years most lessors counted on for the 360 generation.

+ Financially sophisticated firms with experience in computer leasing are turning to lease packaging, lease brokering or "agency" leasing -- arranging contracts between users and investors on a fee basis and avoiding direct ownership of large mainframe portfolios.

Probably the prime example of the new breed of leasing companies is an old leasing company -- Itel Corp. -- which was an early high-flyer in the 360 leasing business. Itel took its losses, revamped its philosophy and has bounced back to become the largest manager of leases on 370 equipment -- \$300 million worth so far, of which about a third is plug-compatible equipment including memory units from AMS and disk drives from its former manufacturing subsidiary, ISS Richard Lussier, president of Itel Data Products, expects these bookings to double to \$600 million by yearend 1975.

In making the jump from 360 to 370 leasing, Itel has transformed itself from an owner/lessor of computing equipment into a "financial and business services" organization. The company lines up lessees, packages leases combining IBM CPUs with Itel peripherals, and finally finds investors and lenders to finance the deals.

Aside from its overhead, Itel invests no money in these fine-tuned financial packages. As the lease manager, it collects a percentage of all lease payments as a fee and takes a share of residual value of the equipment at the end of its leasing life. The leases also are vehicles for the sale of the compatible peripherals Itel markets -- but no longer manufactures. Thus Itel has largely removed itself from the arena of risk, but still makes money from its financial expertise.

The economic life-span of the 370 family is one of the biggest questions confronting the leasing industry. Every lessor is prepared to see IBM introduce a new and possibly very different family of systems by 1977 -- but they differ widely in their views of the impact FS is likely to make on the market. Itel spokesmen point out that users are just beginning to use virtual storage and counts the introduction of VS as the start of a new IBM product cycle -- betting that IBM won't take serious steps to obsolete VS equipment much before the end of the decade. "The U.S. will provide systems growth for the indefinite future," says Lussier. "The installed base will stay viable for a long time no matter what FS looks like." The point is important to lessors not only because they will need to extend or re-lease many of their current contracts in order to recoup their investments, but because most have a stake in the residual value of their equipment. Generally they assume the equipment will really be worth quite a bit more at the end of their payout periods than the minimal salvage value they've allowed for auditing purposes.

PLUG-COMPATIBLE MANUFACTURERS

Differences exist between IDC's estimates of the plug-compatible peripheral market (PCM) and those of IBM's as presented in the written decision formulated by the U.S. District Court, and repeated here in total for reference. While IDC's estimates of the entire 360/370 tape drive and disk drive base coincide very closely to IBM's estimates, the two differ significantly for PCM penetration.

IDC's estimates are based on continual tracking of various product lines by individual manufacturers, and on data derived from its proprietary Computer Installation Data Files which accurately identify the manufacturer, models, and quantities of plug-compatible peripheral equipment installed.

While IDC has not yet been able to reconcile why these apparent differences exist, it nevertheless has a high degree of confidence that its estimates are accurate, after being carefully verified against several internal and external sources, including all of the major PCM manufacturers.

The IBM plug-compatible peripheral market began in 1968 when Telex tape drives and Memorex disk drives first replaced IBM counterparts on 360 computers. Initially created as a means of solely providing IBM 360 users with a comparable product at a lower cost, the market is characterized today by plug-compatible products that also offer performance improvements over IBM counterparts in many instances, with reliable company support and service behind them. The market is still in its growth cycle, despite efforts by IBM (brought out in the Telex case) to counter penetration of its peripheral base.

As shown in Table 119, by yearend 1972 plug-compatible manufacturers (PCMs) had installed 11,050 tape drives and 17,595 disk drives worth $798 million on IBM 360/370 systems in the U.S., giving PCMs a 23.6% and 21.3% share of total tape and disk drives in use, respectively.

TABLE 118

IBM 360/370 PLUG-COMPATIBLE TAPE & DISK DRIVE MARKETS - U.S.
12/72

	Total No. Drives In Use	No. IBM Drives	No. PCM Drives	% Total	Value* ($M)
Tape Drives	46,795	35,550	11,050	23.6%	$276
Disk Drives	82,550	64,955	17,595	21.3%	$522
TOTAL	129,345	100,505	28,645	22.1%	$798

* @ IBM original purchase price.

Growth in various areas within each of these market sectors is varied due to obsolete equipment that is being replaced by new IBM peripheral models and/or new PCM models.

Disk Drives

The plug-compatible disk drive market is dominated by three suppliers who held 74% of the total number of drives installed at yearend 1972 -- Memorex, CalComp (Century Data), and Telex. Memorex was the pioneer in this market with its 2311 version, and still holds a 30% share overall; however, weak financial conditions at Memorex for the past few years have caused the company to lose ground to both CalComp and Telex -- moreso the latter. Table 120 summarizes overall disk drive shares by manufacturer or supplier

Tape Drives

Storage Technology, by virtue of heavy 3420 shipments last year, and few replacements of earlier generation STC drives, holds the number one position in the 360/370 PCM tape drive market with 3100 drives installed.

Telex, with a broad customer mix in all three tape drive product areas, has experienced significant returns of its earlier generation drives, which has resulted in a significant loss of market share over the past two years. (Two years ago it had about 48% of the market.) However, substantial shipments of 3420s should help maintain market position.

TABLE 119

PCM MARKET SHARES
IBM 360/370 PLUG-COMPATIBLE DISK DRIVE MARKET - U.S.
12/72

	No. PCM Drives In Use	% Share
Memorex	5,290	30%
CalComp	4,025	23%
Telex	3,730	21%
Potter	650	4%
Marshall	1,550	9%
Ampex	1,700	7%
Others	1,050	6%
TOTAL	17,595	100%

TABLE 120

PCM MARKET SHARES
IBM 360/370 PLUG-COMPATIBLE TAPE DRIVE MARKET - U.S.
12/72

	No. PCM Drives In Use	% Share
Storage Technology	3,100	28%
Telex	2,900	26%
Potter	2,900	26%
Ampex	1,150	10%
Others	1,100	10%
TOTAL	11,050	100%

MINICOMPUTERS

Growth in numbers of minicomputers shipped continued to show an increase in excess of 50% in 1973, and will maintain levels of 35% or more through 1976, sustained by volume microcomputer shipments beginning in 1975. New applications continue to emerge, and existing users are demanding more and more equipment. The composition of this market is changing slowly, but DEC remains the leader.

Market Definition

For the sake of review, here are IDC's definitional criteria for minicomputers, expanded to include microcomputers, which are simply microprocessor-based minicomputers.

+ The processor is general purpose by design and is sold by the manufacturer as a minicomputer, not as a terminal, small business system, or other computer-based product.
+ The current basic price range for a CPU with 4K words of memory is generally $3,500 to $25,000. Downward extensions of product lines that fall within this price class -- the PDP-8/A, LSI-12/16, and Naked Mini -- are also considered to be part of this market.
+ Word size is typically between 8 bits and 24 bits, although some 32-bit models exist.
+ Memory is typically expandable from 4K to 32K, but some models have capabilities outside this range.
+ Software and peripherals available from the same supplier allow these units to become complete systems.

Table 121 lists all the commercially available minicomputer/microcomputer models that IDC includes in its market estimates. Hewlett Packard's Series 3000, for example, is purposely omitted from the list because its base price is higher than $25,000.

Market

Shipments of minicomputers in 1973 represented a 58% increase over 1972. Continued rapid growth -- compounded at over 30% per year -- will generate for U.S. manufacturers a total market of $2.67 billion in 1978, based on two major factors.

TABLE 121

LIST OF MINICOMPUTER MODELS

Cincinnati Milacron	2002
	2100
	2200
Compiler Systems, Inc.	CSI-16
	CSI-24
Computer Automation, Inc.	108/208/808
	116/216/816
	Alpha-8/Alpha-16
	Naked Mini-8/16/LSI
Control Data Corporation	1700-SC
	Elbit-100
	System 17
Datacraft	6024-5
Data General Corporation	Nova
	Nova-800/820/840
	Nova-1200
	Supernova/Supernova-SC
	Nova 2
Datamate Computer Systems	DM-16
	DM-70
	DM-70/ROM
	ECP-18
	2400
Digiac Corporation	3060
	3080
Digital Computer Controls	D-112
	D-116
	D-216
Digital Equipment Corporation	PDP-8/8e/8f/8i/8m/8l/8s/8A
	PDP-9L
	PDP-11/05/15/20/40/35/45
	PDP-12
	PDP-15
Digital Scientific Corporation	Meta-4
Electronic Associates, Inc.	Pacer-100
Electronic Processors, Inc.	EPI-118/218
Foto-Mem, Inc.	Centauer-100
General Automation, Inc.	GA 18/30
	SPC-12
	SPC-16
	LSI-12/16
GE/PAC	30
	3010
	3010/2
GRI Computer Corporation	909 Series
	99/30
	99/40
GTE/Tempo Computer	I
	II
Hewlett Packard Company	2100-A
	2114-A/B
	2115/A
	2116-A/B/C
	2100-S
	2123-A
Honeywell	112
	116
	316
	416
	516
	700 Series
IBM	System/7
Information Technology, Inc.	4900/5
	4900/10
Interdata	1
	2
	3
Interdata (continued)	4
	5
	15
	16/18
	50
	55
	70
	74
	80
	85
	7/16, 7/32
Lockheed Electronics	MAC-16
	MAC-Jr.
	SUE-110
Microdata Corporation	400
	800/810/812/820
	1600
	3200/3230
	32/S
MiniComp	MD-708
Modular Computer Systems	Modcomp-I/II/III/IV
Mohawk (Atron)	501
Motorola Communications Division	MDP-1000
Nuclear Data, Inc.	ND-812
Omnicomp Computer Corporation	Omnus-1
Omnitec (BIT)	480
	483
Philips	850
Prime Computer	100
	200
	300
Raytheon Data Systems	703
	704
	706
	RDS-500
Redcor Corporation	RC-70
Scientific Control Corporation	4700
Spiras Systems/USM	65
SYS Computer Corporation	500
	1000
	1500
Systems Engineering Labs	71
	72
Texas Instruments	960
	960-A
	980
	980-A
Unicom, Inc.	CP-8A/B/C/D
Unicomp, Inc.	Comp-16/18
Varian Data Machines	520/i
	610
	620
	620/i/f/l
	R620/i
	R622/i
	V-72/73/74
Varisystems	PAC-16
Westinghouse Electric	P-50
	P-2000
	P-2500
Xerox Data Systems	CE-16
	CE-16/S
	Sigma-2
XLO Computer Products	XLO-Eight

+ Microcomputers will allow manufacturers to take advantage of the extreme demand elasticity in this market.

+ Peripheral equipment will provide the means for increasing dollar shipment volume to both existing minicomputer users and to other markets currently supplied by mini-peripheral companies. With far less price erosion, minicomputer manufacturers will find this market sector quite attractive.

By 1978, minicomputers will be buried in so many products -- both inside and outside the traditional computer industry -- that the myriad of future applications would be impossible to enumerate.

Within the computer industry, however, IDC anticipates the effect of network development provides the greatest source of potential over the long term. Minicomputers will serve as various types of components.

+ Large computers will evolve into a series of minicomputer-like modules.

+ Peripheral equipment and network interfaces will consist of minicomputer-based controllers.

+ Remote subnetworks will utilize minicomputers as pre-processors.

And so on. Some will be oriented toward special applications, like POS systems; others will be general purpose. But the concept will focus on the use of minicomputers.

Thus, by 1978, worldwide shipments by U.S. manufacturers will reach about 144,000 units. Growth will still be at the 20% level, with add-on and OEM peripheral equipment revenues offsetting the declining processor prices to keep dollar shipments growing at about the same rate as units.

The international market will continue growing at a faster pace than the U.S. as indicated by Figure 114. Although this sector of the computer industry is one of the few that is not dominated overseas by U.S. suppliers, these familiar names do hold quite significant shares at least of the European market. Most of the business there is end-user shipments because no single market is large enough to support the myriad of systems houses that have sprung up in the United States. Thus, the average system value shipped abroad is somewhat higher than at home.

Who needs all this processing capacity? The list of applications continues to grow. About 60% of the minicomputers shipped in the U.S. (worth almost half the total value) go first to an OEM manufacturer for inclusion in shared processor (data entry) systems, intelligent terminals, turnkey systems for small business, and a growing number of consumer-oriented (autotransaction) products such as point-of-sale systems, automated bank tellers, credit authorization systems, and even automated gas stations.

Minis are used in industrial automation across the board, as concentrators in teleprocessing networks, for plant security, and in special applications such as traffic light control. Furthermore, IBM's entry -- the sensor-based System/7 -- is broadening the market rather than increasing competition as it connects more and more "live" applications to centralized System/370s.

Some dedicated application computers, such as IBM's System/7, can be relatively expensive; others, like those from Microdata, very inexpensive. Across-the-board suppliers such as Digital Equipment have a wide mix, so market share tends to be the same by number of dollars. The primary reason average system cost continues to remain upward of $20,000 is because of peripherals, even though a number of suppliers -- Caelus, Centronics, Dataproducts, Diablo, Iomec, Pertec -- are specializing in miniperipherals. Here's a breakdown of system shipments for the major suppliers of dedicated application computers in 1973:

TABLE 122

Company	# Units	% Total	$M Value	% Total
Digital Equipment	10,800	31.9	$ 242	31.4
IBM	1,500	4.4	90	11.7
Hewlett Packard	2,450	7.2	83	10.8
Honeywell	1,060	3.1	69	9.0
Data General	4,400	13.0	58	7.5
General Automation	2,550	7.5	$ 44	5.7
Varian	1,280	3.8	32	4.2
Interdata	780	2.3	19	2.5
Computer Automation	2,730	8.1	15	1.9
Xerox	140	0.4	14	1.8
Systems Eng. Labs	85	0.3	$ 13	1.7
Modular Computer	485	1.4	12	1.6
Microdata	1,550	4.6	9	1.2
Digital Computer Cont.	900	2.7	5	0.6
All Other	3,190	9.3	65	8.4
TOTALS	33,900	100.0	$ 770	100.0

Mini manufacturers have been trying to make life easier for end-users in recent years by adding high-level language compilers, beefing up operating systems and improving service. But in general, manufacturers haven't been turning out systems ready to go to work for the end-user. The user's only choices are to buy a mini and program it himself, buy his application software from another source, or find a complete design to fill his particular need. The complete "turnkey" system is the easiest way out -- but since mini makers lack the expertise and the capital to turn out such specialized products, they usually aren't available directly from the manufacturer.

This is where the OEM builder will play an increasingly important role in the growth of the mini maker. IDC predicts, in fact, that two-thirds of all new minis will be shipped on an OEM basis by 1977. By marrying minis to end-user equipment -- ranging from data entry systems to traffic lights -- OEMs will bridge the all-important applications gap between user and machine. In many such systems, minis will be nothing more than components buried in larger products.

Mini applications are hard to pin down into categories, but IDC has come up with one approach based on the visibility of minicomputers to their users in the applications concerned:

+ General-purpose minicomputers are purchased by end-users from either a mini manufacturer or systems house for a customized application. The computer is highly visible to the user, who usually does the programming himself. Problem solving/analysis systems fall into this category.

+ Stand-alone commercial data processing systems also are highly visible -- but come with packaged software for general accounting/payroll, etc., within small companies, or other packages for use in a specific sector of a large company's operations.

+ Large computer support systems incorporate minis into some other data processing gear such as key-to-disk systems, graphic displays and plotters, or communications controllers.

+ Automation and control systems combine minis with a non-computer product to improve the efficiency of the system. Process and quality control are major applications; turnkey systems for traffic control and baggage routing are two early examples of mini-supervised products that are beginning to move automation out of the factories.

Significantly, the number of minicomputers in use in each of these application categories goes up as "visibility" decreases -- the "out-in-front" minicomputer is relatively rare compared to the number buried in OEM products, as the following tables show:

TABLE 123

U.S. USER-PROGRAMMED AND CUSTOM-DESIGNED MINICOMPUTERS INSTALLED

	1973	1974	1975	1976	1977
Problem Solving/Analysis	6,000	7,150	8,450	9,885	11,450
Commercial Data Processing	2,600	3,600	4,875	6,535	8,630
Large System Support	7,675	11,900	17,855	25,890	36,250
Automation and Control	9,425	13,200	17,550	22,465	28,070
Mixed	600	900	1,250	1,650	2,050
TOTAL	26,300	36,750	49,975	66,425	86,450
% Total Minis Installed	40%	37%	35%	33%	31%

TABLE 124

U.S. MINICOMPUTER-BASED TURNKEY SYSTEMS INSTALLED

	1973	1974	1975	1976	1977
Large System Support	5,025	8,000	12,325	18,550	26,750
Automation and Control	29,675	46,250	68,700	98,625	132,425
Commercial Data Processing	5,000	8,000	13,000	20,000	30,000
Consumer Products	-	-	-	400	1,375
TOTAL	39,700	62,250	94,025	137,575	190,550
% Total Minis Installed	60%	63%	65%	67%	69%

While these figures reflect changing patterns of minicomputer use, they do not represent corresponding shifts in revenues for mini manufacturers. OEM minis are sold at large discounts -- prices are falling rapidly -- and tend to be small machines. End-user systems, on the other hand, are growing more powerful -- edging toward full scale capability in some cases -- and the average value of new end-user systems is declining much more slowly than average OEM values.

Despite the problems involved in producing turnkey systems for specialized uses, a number of prospective markets for such systems are so large and potentially profitable that mini manufacturers may well be tempted to develop products for them. Some of the most promising of these sectors are:

+ Printing and publishing, one of the first sectors to use minis extensively. DEC is producing a complete typesetting system for publishing houses and diversifying its system for other uses. Some systems in the works will completely automate newspaper composing rooms, processing copy all the way from a reporter's CRT to the printing press.

+ Gas stations and other businesses with dispersed customer bases. Large mini companies are in a better position to provide service to such customers than most OEM houses. Mini-based traffic light systems have proven very efficient in early trials. Auto-tellers for branch bank sites may also become popular mini products.

MAINTENANCE OF COMPUTERS

Customer service has traditionally been a costly, difficult, and complaint ridden business, and data processing equipment maintenance is certainly no exception. EDP equipment manufacturers -- both large and small -- are confronted with the problems and expense of providing maintenance services for their customer base, regardless of whether they are an established company with a nationwide network of customers, or a new or small company struggling to expand its base.

In addition, other equipment outlets such as third-party leasing organizations must be able to offer their customers cost-effective ways in which their equipment can be maintained. And of course, computer users who own their systems require reliable, efficient maintenance services at the lowest possible cost. Few users can provide their own.

+ For the large supplier, the penalty it must pay for its widely dispersed customer base is the necessity to provide adequate maintenance for these users -- reasonably good response and quality of service. For many, it becomes economically infeasible to establish a service office in certain areas where the number and/or size of customers is limited.

+ For the small or new equipment manufacturer, a reasonable level of service support is required concurrent with initial equipment deliveries. The cost justification for establishing its own internal service force is generally totally impractical until a reasonable number of customers in given areas is built up. The point at which it becomes feasible varies dramatically, of course, depending on the sophistication and price of the equipment.

+ For the leasing company -- namely, holders of IBM systems -- its marketing edge is lower hardware prices. Discounted maintenance rates can only serve to enhance the marketability of its systems.

The overall outlook for third-party maintenance within these three major industry groups appears bright. Within the past two years, the participants -- as a group -- have proved that (1) maintenance by a third party can be extremely cost-effective, and (2) it oftentimes can be far better than that provided by the original equipment manufacturer. One of the biggest obstacles for any concept in its embryonic stage is establishing proper credibility -- the independent service vendors appear to have overcome this gap.

Users of their services -- both the OEMs themselves and the equipment end users -- indicate that they have been pleased with the quality and responsiveness of service. What remains then is continued geographic expansion and development of a broad level of expertise to enable them to be as flexible as possible, adapting themselves to the needs of the various industry markets. There is no indication at this time that this direction cannot be successfully followed.

DATA COMMUNICATIONS

Among the more adventurous, forward-looking computer operations, the advantages of using data communications techniques have gained increasing visibility for the last five years or so. But recent events have marked the beginning of an exceptionally high growth period for this sector.

+ IBM -- with three new products, the 3735 printer processing terminal, the 3705 communications controller, and the 370/158 and 168 virtual storage computer systems -- has apparently started to take an active interest in communications network implementation.

+ MCI's first operating link -- from Chicago to St. Louis -- and the threat of imminent competition elsewhere brought retaliatory announcements from AT&T regarding the availability of its Data Under Voice (DUV) technique and Digital Data System (DDS) network, beginning in 1974.

+ Point-of-sale and other autotransaction systems have begun to achieve significant popularity, suggesting the potential of special-purpose terminal systems in many application areas.

And there is no indication that this growth will level off even by the end of the decade.

By that time, however, the data communications market will have taken on a different shape from that of today, and terminals will bring computers increasingly close to consumers:

+ IBM -- though still a primary force -- will not dominate all sectors. Competition from the communications carriers and special-purpose terminal suppliers will open up significant new market pockets where IBM may choose not to participate at all.

+ New transmission networks, geared especially for data, will greatly simplify the types of interconnection equipment required. Digital networks, for example, will eliminate the need for modems.

+ Application-unique terminals will predominate, as general-purpose terminals find fewer and fewer new user pockets to penetrate.

Emerging Trends

By the mid 1980s, data communications networks may well be effecting significant changes in our very life style. Joining the power of the computer with the transmission capabilities of communications networks creates an environment conducive to whole new ranges of potential applications and markets. Some of these are highly desirable; some are currently considered potentially destructive of the American way of life.

Information utilities will draw on up-to-date data bases, providing businessmen and consumers alike the ability to obtain the latest word on almost any subject -- from news and weather to yesterday's production totals to a hospital lab report entered only a few minutes before. Corporate computer operations are already on their way to becoming data utilities rather than functional service bureaus, but few have yet recognized the extent of this implication. In five or ten years, they will find themselves providing the instantaneous availability of enormous amounts of information to managers at all levels, rather than simply performing the service of payroll generation or invoicing. Even the payroll function itself could be carried out simultaneously with time sheet approval (or automatically, in the case of exempt employees) -- all by computer terminal. The paperwork syndrome will gradually disappear in favor of the terminal syndrome.

The checkless society is also beginning to evolve. At least one prominent bank is developing a point-of-sale system for its bank credit card customers. Many more already have cash dispensers that use credit cards. Integrating these with an automatic payroll check deposit system would greatly reduce the usefulness of checks even now.

And the increasingly widespread use of cable television (CATV) will bring computer use right into the home. Many long talked about services will finally become a reality.

+ Consumers will be able to select from current movies for their home viewing pleasure.

+ Catalog shopping and other direct mail solicitation will become interactive entertainment -- until the bills arrive or the funds disappear.

+ Health care distribution will be far more flexible and economical.

+ Fire and police protection will achieve increased effectiveness.

+ Computer-aided instruction will finally become a cost-effective teaching technique.

+ Interactive public opinion polls will eliminate the time lag currently required.

Many more ideas will appear in rapid succession, but all of them are significantly more long-range and controversial in nature than those mentioned previously.

In Europe, a similar transition has begun to take place. Some current teleprocessing networks there are every bit as sophisticated as some of their counterparts in the U.S. But the overall changes will be quite different because European society has never incorporated on a large scale many of the American features -- such as checks and deferred payment plans -- that are so common here.

These trends are inevitable, but the changes will take place gradually. Consumer demand is more difficult to generate than industrial interest and political roadblocks will also slow the evolution.

The Increasing Demand for Communications

The technology is already here, and the rate at which businesses implement teleprocessing networks is picking up rapidly. By 1977, the total number of computers supporting terminal/communications networks will be about 2-1/2 times as many as in 1972. The greatest growth will occur among the smallest and largest CPU size classes.

The market for data communications equipment will expand even more. Interconnection equipment sectors will grow as a function of the increasing complexity of networks.

+ The number of modems installed will bear a direct relationship to the number of terminals in use on nondigital networks. The product mix will depend on the terminal types -- and therefore speeds -- used.

+ The number of controllers/communications processors installed will also depend on the number of terminals, but the types will vary according to the individual network complexity -- size, geographic dispersement, diversity of terminal types, and polling requirements.

The number and types of terminals installed, on the other hand, will depend almost entirely on application implementation. Three distinct phases are involved as organizations evolve toward network implementation:

+ Phase 1 focuses on reprogramming existing local batch applications -- usually those affecting sales volume and customer service -- for operation in a communications mode.

+ Phase 2 usually involves additional terminals, but smaller remote CPUs, and implementation of applications relating to costs, such as inventory control.

+ Phase 3 emphasizes scientific management capabilities, using the enormous data bases built up over Phase 1 and 2 as foundations for simulation and modeling techniques for more knowledgeable decision making.

But every equipment/application combination is completely individual, governed by factors unique to each organization.

Some of these unique factors also dictate each company's stage of network implementation. The teleprocessing concept has caught on more rapidly in some industry groups than in others. Some natural reasons exist for this phenomenon.

+ Transportation/communication/utility organizations are networks in themselves; therefore, they are naturally prone to establishing computer networks to enhance their operations.

+ Among the financial sectors, banks also tend to be networks, but on a smaller scale; consumer finance companies tend to be even more highly prone to network use because their information needs are so urgent; insurance companies tend to lag slightly behind their more money-oriented counterparts.

+ Trade organizations -- wholesale and retail -- offer more limited potential because of the preponderance of small firms, but are on a par with the industry groups already discussed with respect to implementation versus potential.

+ Manufacturing organizations, on the other hand, have relatively much higher potential because they tend to support several CPU installations already. But this industry group is lagging in network development compared to potential.

+ The medical/health services industry is undercomputerized overall, thus showing a high incidence of terminal use per CPU installed. This sector represents a high growth area in all computer industry sectors.

INTERCONNECTION EQUIPMENT

The 1968 FCC ruling that independent interconnection equipment could be legally connected to the switched telephone network gave significant impetus to an industry that has since become a major sector in the data communications market. The resulting proliferation of vendors has afforded data communications users the opportunity to design more flexible, cost-effective systems by choosing from a wide array of equipment.

Teleprocessing users typically spend $50,000 to $75,000 per month on network use, with interconnection equipment accounting for about 4% of that total -- a seemingly small percentage. But teleprocessing network development is still in an embryonic stage, implying a proportionately low level of interconnection equipment use compared to potential.

As pointed out in the previous chapter, users generally advance through three distinct phases of network development, each of which tends to increase the complexity of the total network. This increased complexity dictates the need for more sophisticated, but flexible, interconnection equipment, which becomes an increasingly important part of the network. For example, a network that was originally configured with a limited number of low-speed terminals linked to a hardwired controller such as the IBM 2701, might often evolve into one that utilizes a high number of both low-speed and high-speed terminals at several remote locations that can only be tied together effectively through a combination of multiplexers or line concentrators, and a programmable communications front end.

Because of this progressive network evolution, interconnection equipment continues to represent a greater proportion of these users' budgets.

Competitive Environment

The interconnection equipment market -- until recent years -- has been characterized by lagging equipment development and unaggressive marketing efforts. AT&T, because of its monopolistic hold on the communications sector, has had little motivation to develop high-performance, low-cost equipment. Data communications revenues account for an estimated less than 3% of AT&T's total revenues. However, both the Carterfone and the more recent MCI ruling have apparently caused AT&T to react to competition. Several moves have enhanced transmission service and equipment offerings.

Within the computer industry itself, the mainframe manufacturers were once guilty of slow interconnection equipment development and ineffective marketing. However, this posture has changed during the past few years as a result of both increasing competition by the independent equipment suppliers and an increased awareness of what teleprocessing users are willing to pay for.

IBM traditionally has not been as strong in the teleprocessing segment of the computer industry as in other areas, holding less than a 50% share of most subsectors. However, its thrust during the last few years has emphasized data communications. It has announced and delivered several new price-competitive terminal devices, as well as new programmable communications controllers.

But despite this increased activity by industry participants, very few suppliers of interconnection equipment can claim to offer a full complement of equipment to serve all the teleprocessing user's needs.

+ There are currently over 90 modem companies in operation, selling a variety of devices to both OEMs and end users, but less than 30% of these companies can also offer some other type of interconnection equipment.

+ Of about 20-25 companies who produce multiplexers, most supply modems, but very few also produce some form of communications controller or processor.

+ About 50 companies offer communications controllers or processors, but less than four also produce modems and multiplexers.

Like users in other sectors of the computer industry, teleprocessing users prefer to have a single supplier for all their interconnection needs. With the exception of the large, more independent users, they look to the mainframe manufacturers or AT&T to simplify the entire process. As a result, industry participants -- especially modem manufacturers -- are under user pressure to broaden their product lines.

Independent modem manufacturers have been increasing their share of the market, and will continue to penetrate AT&T's domain over the next several years. But their rate of penetration will slow considerably as a result of increased competition by AT&T itself, the mainframe vendors, and some of the OEM customers, who will develop in-house capabilities in order to remain flexible.

Once AT&T begins operating its all-digital, private-line network in 1974, competition with AT&T for users on this network will stiffen considerably. The modem as we know it today will disappear; in its place will be a digital interface device attached between terminals or

CPUs and the transmission line. AT&T has already indicated that its Data Service Units (DSU), which will be used to connect carrier equipment to the network, will be inexpensive. It will also offer an attachment analogous to its Data Access Arrangement (DDA), which is required today for users of non-carrier equipment on the switched network. Called the Channel Service Unit, this device will provide only some of the functions accomplished by the Data Service Unit; the user will have to obtain the other functions through his independent supplier. Whether independent equipment manufacturers will be able to provide these functions within their own equipment and still compete with the low price of the DSU is a major question. But the requirement for modems on switched lines will remain, albeit a smaller proportion than in the past.

Communications Controllers/Processors & Multiplexers

The communications control function in teleprocessing networks has assumed an increasingly important role over the past few years, as existing networks have progressed through their evolutionary development. Users are configuring high-volume systems that use a variety of terminals and a mixture of line disciplines and speeds, creating the need for flexibility and sophisticated network design. These configurations demand much more than can be accomplished through the use of rigid, hardwired controllers, multiplexers, and concentrators -- the primary offerings of most interconnection equipment suppliers for the past several years.

But rapid improvements in minicomputer technology and price/performance levels over the past three years, have fostered the growth of a new breed of fully programmable control devices, capable of handling a significant portion of the teleprocessing load. The ability to meet the changing requirements of these systems is paramount, especially in view of the vast array of terminal devices available to today's independent-minded user. The most practical solution is through software; the same controller can emulate several host devices, while simultaneously handling the concentration, multiplexing, speed, and code conversion of many different remote devices. The second consideration that is important today -- and will be moreso in the future -- is the ability to reduce the overhead on the host CPU. It is not uncommon to find a CPU in a teleprocessing network spend over 60% of its time handling the teleprocessing chores -- terminal polling, message routing, code formatting and conversion, and so on. For a medium- to large-scale CPU, such as IBM's 370/155, this is an extreme waste of CPU capability. Alternatively, a programmable processor linked in front of the CPU can execute these functions, freeing the host CPU for tasks better suited to its capabilities.

Programmable controllers -- or processors -- are nothing new to this industry, but the price/performance levels available today certainly are. A previous lack of network sophistication and volume, combined with the disproportionately high costs of the controllers and processors available, stymied the growth of this market. But programmable device costs are now comparable to their hardwired counterparts, in many instances, while offering enormous increases in capability. And more important is the entrance of IBM -- with its 3705 controller -- into this market segment.

Hardwired devices like the IBM 270x series that have been around for some time outnumber programmable controllers and processors by fourteen to one. At yearend 1972, for example, there were 17,175 controllers installed on general-purpose teleprocessing computer systems, but less than 1,200, or 7% of these controllers offer processing capabilities. However, this situation will change fairly rapidly. IDC estimates that by 1977, programmable devices will constitute about 45% of all controllers in use.

The average number of controllers installed will drop from 1.2 per CPU in 1972 to 1.04 by 1977, as a result of displacement of several hardwired devices by a fewer number of programmable devices. Recent surveys conducted by IDC have revealed many cases where three or four 270x devices were replaced by a single 3705. Therefore, while the number of controllers in use will not increase as much as one might expect, the average dollar value of shipments will certainly increase at a much greater rate.

DATA ENTRY

As the computer industry enters the communications era, the data entry market, too, is gradually changing its complexion. The traditional keypunch room itself may even disappear. Although the ever popular keypunch will continue to dominate the environment for several years, the change to more sophisticated techniques -- already occurring at the largest sites -- will eventually filter through the entire spectrum of data processing installations.

As the 1970s began, recession-constrained budgets caused users to demand more efficiency, economy, and flexibility -- even at the cost of changing procedures. As a result, shipments of standard keypunch equipment started to fall while total data entry shipments increased more rapidly than computer equipment as a whole. This trend has continued:

+ Shared-processor systems reached volume delivery levels and began rapidly penetrating installations interested in expanding and utilizing the intelligence now available in the data entry environment.

+ OCR systems decreased in price, significantly widening the range of applications for which they are economically justifiable.

+ Direct data entry has been fostered by IBM -- long accused of foot-dragging to protect its keypunch base -- and the user can now consider upgrading directly from the keypunch to the intelligent terminal.

+ Point-of-sale terminals became widely accepted by the retail industry, setting the stage for a wider variety of special-purpose data entry devices (information appliances) in other industries as autotransaction takes off.

The change, though slow, is clearly beginning to evolve, and 1975 will see a completely different product mix from that of 1965, when the keypunch was virtually the only alternative.

The trend away from the standard keypunch is beginning to infiltrate smaller installations, but as Table 125 shows, the move will be slow. Even in 1976, <u>the keypunch will still be with us</u>.

+ The installed base will actually continue to grow through 1974, buffered by new 80- and 96-column buffered units offsetting the retirements of the old 80-column unbuffered ones.

+ In 1976 the total keypunch base will still exceed that of all other data entry products combined, except terminals.

In all, however, over 112,000 traditional 80-column, unbuffered keypunches will disappear over the next five years.

Other segments of the market can look forward to a more exciting future.

+ Shared-processor systems will see the greatest growth, quadrupling in number, although this growth will slow in 1975 and 1976 as direct data entry becomes more popular.

+ Terminals will sustain their current growth rate throughout the entire period, with that portion used primarily for data entry increasing significantly. There will be a shift toward special-purpose terminals (information appliances) as autotransaction blossoms.

+ Optical character recognition (OCR) equipment will continue reasonably strong, spurred by the introduction of low-cost equipment will be the major factor in maintaining this position. But the accompanying need for resystematization will still prevent OCR's widespread use outside of label scanning in retail autotransaction systems.

Key-to-tape equipment, on the other hand, has passed its peak. Retirements have begun to exceed shipments.

TABLE 125

ESTIMATED U.S. DATA ENTRY EQUIPMENT MARKET
NUMBER OF UNITS IN USE -- 1972 TO 1976

	1972	1973	1974	1975	1976
80-Column Unbuffered Keypunch	179,500	158,300	135,100	110,100	87,100
80-Column Buffered Keypunch	58,000	78,900	99,050	113,700	124,900
96-Column Buffered Keypunch	25,600	35,600	42,800	47,260	50,000
SUBTOTAL KEYPUNCH	263,100	272,800	276,950	271,060	262,000
Single-Station Key-to-Tape Units	52,300	52,300	51,250	49,200	46,250
Shared-Processor Systems	18,800	28,600	36,050	40,400	41,600
CRT Terminals[a]	66,500	85,800	110,000	140,000	176,400
Non-CRT Terminals[b]	216,000	280,000	350,000	420,000	486,550
SUBTOTAL TERMINALS[c]	282,500	365,800	460,000	560,000	662,950
OCR[d]	2,160	2,640	3,220	3,895	4,670
TOTAL	618,860	722,140	827,470	927,555	1,017,470

(a) Excludes dedicated terminals such as Bunker Ramo Telequote and IBM 2900. Growing portion of units forecast for each year will be input-oriented.
(b) Includes Teletype, IBM 2741s, etc. Growing portion of units forecast for each year will be input-oriented.
(c) Does not include remote-batch terminals or data collection systems.
(d) Document and page readers only. Does not include MICR, journal readers, mark sense readers, or bar code readers.

TERMINALS

Of all the major sectors in the computer industry, the terminal market will achieve the most spectacular growth over the next five years. As the number of general-purpose computers doubles from 1972 to 1977, the total number of terminals connected to those CPUs will more than triple.

+ General-purpose terminals will increase from 303,000 installations in 1972 to over 960,000 in 1977, with the emphasis on increasing amounts of remote processing power.

+ Application-unique devices -- the so-called appliances of the computer industry -- will experience a snowballing growth rate from its current 90,000 installation base, with no saturation point in sight.

Today's terminal market is highly fragmented and the emerging trends will probably make it even moreso.

+ IBM -- dominating less than half of the general-purpose terminal market and paying only token attention to date to the special-purpose portion -- has never been a leader in the trend toward communications use.

+ Other mainframe manufacturers have captured little pockets of terminal use both among their own CPU customers and within IBM's customer base, but have made no major impact on the total market.

+ Except for Teletype Corporation, no single independent vendor holds a major market share in any general-purpose terminal market subsector.

+ All special-purpose terminal sectors are dominated by one or two suppliers, but as new application areas emerge, new vendors will probably enter the marketplace to control them, leaving the total marketing effort as dispersed as the industries served.

Despite this dispersion, however, some firms will prove highly successful, either by taking advantage of IBM's marketing muscle, offering plug-compatible equipment much as the peripheral manufacturers do, or by accurately assessing the emerging trends and leading the way.

In any case, at least $8-10 billion of new equipment will be installed over the next five years as remote devices communicating directly with a host CPU -- a market sufficiently large to support a significant number of participants adequately.

Market Size

For purposes of estimating market size, IDC has defined terminals as all devices that can transmit (and receive) data to (and from) a CPU via communications lines. Some terminals may operate off-line most of the time and transmit accumulated data only periodically; others -- like remote CPUs -- may even perform some processing before transmission. In addition, some terminals are not actually at remote locations, but they can perform the same functions as remote terminals and communicate directly with the CPU, so IDC includes them in this market definition. With respect to Teletype terminals, IDC's estimates include only that portion of total installations (other than consoles) that is used in conjunction with computers.

At yearend 1972, the International Data Corporation's count of all terminals used with computers in this country was as follows:

TABLE 126

U.S. TERMINAL MARKET, BY NUMBER OF UNITS, YEAREND 1972

Manufacturer	Installed Base
IBM	150,000
Teletype	80,000
Other Mainframe	31,000
Independents	132,000
TOTAL	393,000

A potential numbers game race between IBM and AT&T plus the serious start of what may be a vast special-purpose terminal, or information appliance market, illustrate that terminals of all sorts -- intelligent, editing, batch, conversational, application-unique . . . any device that can transmit and receive data to and from a CPU via any type of communications link -- are going to grow dramatically in numbers during the 1970s and beyond. Among some of the more specific trends:

+ General-purpose terminals connected to general-purpose CPUs (see Table 125) are growing at about 25% a year and will triple in number -- to almost 1 million -- by 1977. During this same five-year time period, the number of CPUs will only double.

+ Application-unique terminal devices will bring the computer closer and closer to the consumer. These information appliances are destined to achieve the most spectacular growth within the terminal sector; no saturation point is in sight as new applications continue to come to the forefront.

+ A potential battle is shaping up between IBM and AT&T -- at least in the general-purpose terminal sector. But amid the intense competition and the large number of terminal manufacturers, much maneuvering for position remains to be done, even in general-purpose terminals.

+ In the application-oriented area, it's difficult to determine whether a handful of leaders will emerge . . . or whether fragmentation by application will continue, with no overall leaders.

+ The greatest predictable growth rates will be among processor terminals such as the IBM 3735, the Sycor 340, and the Datapoint 2200.

+ IBM -- with less than half the general-purpose market and currently paying only token attention to the special-purpose portion -- stands to be most impacted by the increased use of terminals. Despite IBM efforts, views are changing as to the amount of centralized CPU processing power really needed for efficient system utilization.

+ There seems to be room for everyone. With $8 billion to $10 billion worth of equipment expected to be shipped between now and 1977, a real sellers market seems to exist. Even AT&T has expressed concern about meeting demand for its Dataspeed product line.

Amidst all the glowing prospects -- especially for the independents -- for burgeoning terminal equipment growth, there is confusion, some of which has been building for at least two years. How do you define, or even categorize terminals?

Types of Terminals

After considering the various types of terminals already in use plus those announced and scheduled for delivery, IDC decided that a breakdown by end-user thrust (examining the flow of data in and out) is perhaps the most meaningful classification criteria:

+ Operator-oriented terminals consist of a keyboard for input and either a printer or a CRT for output. These condense the traditional two-step data entry function into a direct, one-step process but there are at least subsets: conversational terminals (such as Teletype 35s and IBM 2741s); editing terminals (such as the IBM 3270) with extensive error correction and block transmission facilities; and processing terminals (such as IBM's 3735 and the Burroughs TC 500) which are programmable and provide processing power as well as editing capabilities.

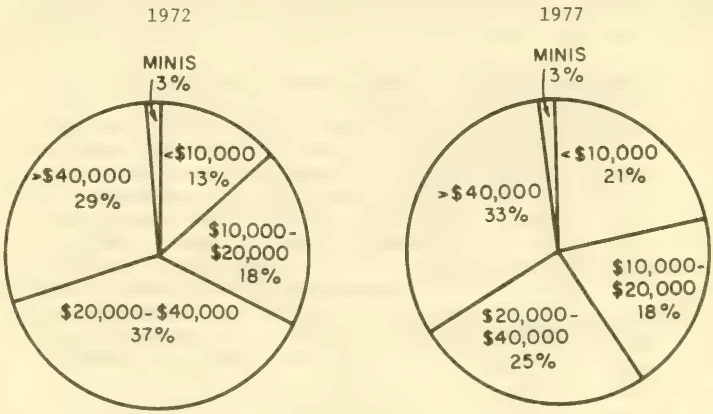
+ Machine-oriented terminals normally transmit input from machine (CPU) to machine, and receive output in the same manner. The important distinction here is that the operator communicates only indirectly with the host CPU. This class consists of batch terminals; remote CPUs; and "other" remote devices (such as OCR readers or tape transports).

+ Application-unique devices provide input and/or output in such a way as to make the device useful for one or a limited number of specific applications. The entire product is geared only to that application, it is priced in relation to the costs of the application, and often (for the present, at least) it looks more like the manual equipment it replaces than a piece of computer gear. Among the more prevalent applications so far are stock quotation consoles, bank teller terminals, credit verification systems, and point-of-sale terminals . . . information appliances.

The Markets

As new applications arise, or new products come along, the above categories will likely need change or supplementation. Indeed, today's so-called intelligent terminals actually fall into all three -- and they may well be used for many application-unique applications by the use of special programming and/or customized keyboards. But for today, at least, growth trends for the terminal marketplace can best be tracked on this basis.

TABLE 127
DISTRIBUTION OF GENERAL PURPOSE TERMINALS BY CPU SIZE



This growth will come because three factors that exist in the industry will cause an accelerator effect:

+ The number of general-purpose computers will double during the 1972-1977 period.

+ The average number of general-purpose (operator and machine oriented) terminals connected to each CPU that supports terminals will also grow from 20 to 29.

+ Existing networks will begin adding terminals to small remote CPUs as management inquiry applications increase. Smaller companies will begin to follow the lead of larger trend-setting organizations and start to establish networks of their own.

The result of all this will cause a seven to ten-fold increase in the number of general-purpose terminals attached to System/3s and 360/20s -- or their equivalents five years hence -- compared to a mere tripling for general-purpose terminals overall. Also, substantial growth will occur among large CPUs, where approximately one-third of all general-purpose terminals already exist. Thus, it appears that users will take fuller advantage of already-established patterns for centralization of CPU power. This will undoubtedly affect equipment acquisition patterns, especially when application-unique terminals are also considered.

COMPUTER SOFTWARE

Software is the element that differentiates computers themselves from other types of computing machinery. This man/machine interface stems from many sources in various forms, but by imposing reasonable limits and a logical segmentation one can discuss the actual software market with only a minimum of confusion.

Scope of the Market

The software market as defined by IDC includes all revenues that derive from computer users' spending on software developed by outside sources -- mainframe computer manufacturers, independent software suppliers, and other users. This definition automatically excludes at least 90% of all the software actually installed today.

+ In-house programming and systems engineering staffs account for 20% to 25% of salary expenditures.

+ Free user libraries exchange large numbers of programs each year.

+ Mainframe manufacturers provide significant portions of the software for their systems without additional charge.

+ Private software swaps never receive sufficient visibility to allow estimates of their value.

All of these software sources are substantial, but none generates a significant amount of software revenue for any additional organization.

In addition, several gray areas exist for which the inclusion of revenues in the software market would necessarily involve double counting with other discrete industry markets.

+ Computer service firms provide specialized software for their clients in order to generate additional computer time sales. These revenues, however, are part of the computer services market and appear as software expenditures only insofar as independent software firms receive payment from the service bureaus for the use of the software.

+ Facilities management services -- an outgrowth of custom software development -- combine hardware and operations costs with those for software. Differentiation would be an impossible task.

+ Turnkey systems are much like packaged software, but inextricably include expenditures for hardware.

IDC omits the latter two product types from its definition of software since their inclusion would produce extremely misleading figures.

To provide a framework for better understanding the patterns and emerging trends, IDC imposes on the software market the six-cell matrix shown in Figure 128.

Vendors can provide software under either of two arrangements.

+ Packaged software fills the needs of multiple clients, with little or no modification. Anyone with an appropriate hardware/software configuration, for example, can implement ADR's AUTOFLOW on his system to obtain program flowcharts.

+ Custom software solves the specific problem of a single client as a one-time project. A stock exchange automation system is unique to the particular client for which it is designed.

Each arrangement implies a given set of development and marketing parameters. Packaged software requires greater flexibility for its variety of users, as well as detailed, unambiguous documentation, and active promotion campaigns. The financial burden, however, is split among numerous clients, whereas the custom software client must cover the entire development cost himself.

Implementation of any software product -- packaged or custom-developed -- occurs at one of three levels of system use.

+ Systems software performs basic machine operation (the executive program or operating system), provides the raw man/machine interface (language compilers and assemblers), and routes, assists, or monitors the flow of data among machine units (system information management, access control, computer usage measurement, etc.).

+ Utility software manipulates, converts, or organizes data (sort/merge, media conversion such as tape-to-print, report generator, etc.), or performs applications tasks that aid programmers and other data processing personnel in their jobs (flowcharting, test data generation, etc.).

+ Applications software solves problems unique to an industry or to a specific department within a user company. The most obvious and popular applications program today is payroll.

Market characteristics vary among systems, utility, and applications software but not quite as obviously as between custom and packaged software. Most difficult to distinguish is the difference between systems and utility software; however, the definitions above are reasonably precise and reference to them should answer whatever questions may arise elsewhere in this report.

	SYSTEMS	UTILITY	APPLICATIONS
PACKAGED SOFTWARE	IBM's Disk Operating System (DOS) SDI's GRASP 360 enhancement package	ADR's AUTOFLOW flowchart package Informatics' MARK IV file Management package Comress' SCERT system performance simulator	PHI's Generalized Payroll System PMI's Corporate Shareholder System
CUSTOM SOFTWARE	Few exist	Few exist	Stock Exchange Automation Law Enforcement System

Figure 128
SOFTWARE MARKET SEGMENTATION WITH EXAMPLES

COMPUTER SERVICES AND AUTOTRANSACTION

The Computer Services Industry is a $2 billion market experiencing current growth rates of better than 20% per year. The Autotransaction (AT) Industry is a $1 billion market experiencing current growth rates of better than 50% per year. Included as part of both industries is a segment IDC identifies as AT-Computer Services. Because of the high degree of overlap between those two industries; 34% of the Computer Services Industry is AT-Computer Services and 58% of the Autotransaction Industry is AT-Computer Services.

Computer Services

After several years of monitoring the growth of computer services, IDC in 1971 first published a rather extensive set of definitions for the computer services industry, subdividing the industry into a three-by-three matrix of nine distinct cells that are mutually exclusive and collectively exhaustive. These segments are defined by the way the computer is used:

+ From the user's point of view -- batch, remote-batch, or remote access/immediate response (Rair);

+ From the computer's point of view -- raw power or calculation, transaction processing, or data base inquiry/table lookup.

These factors are illustrated in Figure 129.

Access by User

There are three ways a user can interact with the computer, and these determine three classes of services:

+ Batch services involve no direct communication between the user and computer. The user takes or sends his punched cards, business forms, magnetic tape or whatever to the service bureau and the bureau returns the results. In its most primitive form, the user may actually operate the computer, but generally the computer run is performed by the bureau.

+ Remote-batch services require the user to enter his own data or program through a terminal connected to the computer (usually by communications lines). The user sets the process in motion by giving the computer its proper

instructions through the terminal. At that point in the process, the user can disconnect his terminal or use it for another job; he need not intervene further until the run is complete. The computer may not and usually doesn't run the job right away; rather, it schedules it for later processing. When the user wants his results, he reconnects and the computer transmits them.

+ Rair services involve interaction between the computer and the user while the program is running. To the user, it appears that he is the sole user of the computer -- making inquiries, supplying data to a program, and receiving answers or output from the computer.

Function of the Computer

The computer, no matter how it is accessed, can supply three types of service to the user. These are defined by what the computer does for the user. Distinctions are based on whether the user supplies his own software; whether the service vendor supplies extensive amounts of data; and how the user is charged for the service.

+ Raw power applications. In this mode of operation, the user is generally running his own programs and he is charged according to the computer resources used in terms of time and capacity. Even if the vendor supplies some programs or data (at additional cost or not), raw power applications are distinguished from other types because the user is charged for the amount of time he uses and is able to execute the programs at will. The vendor merely operates the system without complete awareness at any point in time of exactly what the computer system is doing.

+ Transaction processing. Rather than paying for the amount of time used, the user operating in this mode pays for the number of transactions processed. This may be measured in terms of input or output documents. The data being operated on is totally the user's; his master files are being updated. The software being used is totally the vendor's; a turnkey service is being provided. Generally, vendors of transaction services dedicate their system to a particular service and hence are totally aware at all times of exactly what the computer is doing.

+ Data base inquiry. In this mode, the primary resources being offered by the vendor is a data base of some nature. In many cases, the user is charged solely for the number of accesses he makes to the data; in some cases, however, he is charged an additional amount that reflects the

FIGURE 129

EXAMPLES OF COMPUTER SERVICES CLASSIFIED BY ACCESS METHOD

In each cell are listed leaders in that cell, and a general description of the service.

	Batch	Remote-batch	Rair
Raw Power	Many small firms Walk-in service bureau	Control Data Corporation Scientific RJE University Computing Scientific RJE	General Electric Timesharing Tymshare Timesharing
Transaction Processing	Automatic Data Processing Payroll Itel Data Processing Accounts Receivable	Computerized Automotive Reporting Service, Inc. Automobile Dealer Records	Keydata Invoicing/Accts. Rec. NCR Savings Bank Accounting
Data Base Inquiry	Chilton Corporation Consumer Credit Bank Computer Network Portfolio Evaluation	Westat, Inc. Census Data	Bunker Ramo Stock Prices International Reservations Hotel Reservations

computer resources used. The retrieval software is the vendor's, but the user may supply his own manipulation software. The vendor knows that the use of his system centers around data access, but he may not know what the user is doing with the data.

Market Shares

Consolidation has clearly taken place - during the past few years - most significant is the merger of Service Bureau Corp. (a former subsidiary) with Control Data Corporation forming a powerful service combine which also includes Ticketron and pieces picked up from ITT Data Services.

TABLE 130

Computer Services Market Share Leaders

Control Data	$ 150 million	6.7%
Electronic Data Systems	100	4.5
General Electric	85	3.8
Automatic Data Processing	85	3.8
Wyly	45	2.0
Bradford Computer & Systems	45	2.0
Bunker Ramo	45	2.0
National Cash Register	35	1.6
Statistical Tabulating	30	1.3
McDonnell Douglas Automation Company	30	1.3
	650	29.0%

IDC expects the consolidation trend to continue. In addition to companies such as National Data, Tymshare, National CSS, and Computer Sciences -- all close to the size of the companies at the bottom on the list above -- several large companies with virtually no computer service revenue at present have stated business objectives of becoming industry leaders by 1980.

As this consolidation continues and the services industry grows at greater than 20% a year, IDC expects the distinction between some of the cells in its matrix to wane, then vanish. The chart below shows the distribution of the $2.2 billion services revenues in 1973 -- and the expected arrangement for this industry segment that will be almost twice its present size after only three years:

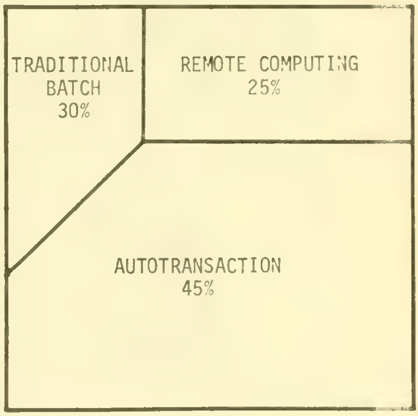
TABLE 131

CHANGING STRUCTURE OF COMPUTER SERVICES INDUSTRY
(Worldwide Revenues of U.S.-Based Companies; IDC Estimates Copyright 1974)

1973: $2.2 Billion

Batch Raw Power 4%	Remote Batch Raw Power 8%	RAIR Raw Power 14%
Batch Transaction 59%	Remote Batch Transaction 1%	RAIR Transaction 5%
Batch DB Inquiry 1%	Remote Batch DB Inquiry 1%	RAIR DB Inquiry 7%

1976: $4 Billion



Autotransaction

The Autotransaction Industry did not exist prior to 1973. The pieces existed, but the determination that these pieces could be joined to form an industry did not happen until 1973. Like the Computer Services Industry, the Autotransaction Industry is not just one business, rather it is several hundred businesses that have a common theme:

+ Products (including services) are computer related and are elements of other EDP industry segments;

+ Products are designed to meet the needs of one specific industry or application;

+ Products assist in the input or output of transactions to or from a data base, or perform the entire function;

+ Products are intended to be marketed to more than one customer.

A more complete definition is contained in the Definition section.

Table 132 presents a Review and Forecast of major segments of the Autotransaction Industry.

TABLE 132

AUTOTRANSACTION INDUSTRY -- A REVIEW AND FORECAST

(Worldwide Revenues, in $ Millions, of U.S. Suppliers)

	1972	1973	1974	1975	1976	1977	1978
Batch Transaction	$ 285	$ 360	$ 440	$ 515	$ 595	$ 685	$ 790
Remote/Inquiry Services	270	410	605	860	1185	1580	2065
Information Appliances	150	340	640	1090	1740	2700	4050
Turnkey Systems	40	80	150	265	450	725	1085
Miscellaneous	105	145	205	285	390	515	660
TOTAL REVENUES	$ 850	$1335	$2040	$3015	$4360	$6205	$8650

The advent of autotransaction will have a two-sided effect on the computer industry. First, the demand for autotransaction products and services will keep the computer industry running at a steady pace for years to come despite the maturity of the industry. Second, autotransaction will bring about changes in the total computer industry's life style ... especially in the way the industry looks at itself and its users.

The impact of autotransaction will be felt most heavily in four areas of the traditional computer marketplace: minicomputers, terminals, services, and software. It also will affect the market for data entry equipment, though to a lesser extent.

These traditional mainstays of EDPdom have already developed strong autotransaction subsegments that keep their growth ahead of the rest of the industry. The effect of autotransaction on the "lifestyle" in these computer sectors promises to be as profound as its effect on the growth curve ... because the expansion will be due in large measure to the introduction of whole new categories of offerings, such as:

+ "Information appliances" transforming the terminal marketplace. A good example of an information appliance is the familiar point-of-sale cash register terminal. Like a household appliance, it is a sophisticated tool and a "work-saver" that hides its sophistication. The information

appliance has already turned the terminal market around ... IBM is offering its store terminals on an unprecedented purchase-only basis, for instance ... and more surprises should be expected from further growth.

+ "Turnkey systems" injecting life into the minicomputer market. Like the information appliance, the turnkey system is primarily designed to be transparent to its users while solving a particular problem. The minicomputer manufacturers, as they seek to diversify operations, are turning to the turnkey marketplace ... where they find a distinctly new and different environment ... an atmosphere more oriented to the user than to mass production. But they, just like their OEM customers, are determined to switch to autotransaction products.

+ Autotransaction services continuing a winning autotransaction formula. The services dominate the autotransaction industry because service long ago abandoned the hardware orientation of the computer industry as a whole. The style of the services market ... with the accent on applications and "doing their thing" better than anyone else ... will be the fashion in autotransaction.

Autotransaction will create a ripple effect in the computer industry as it remakes the style of marketing and production. Some of the global considerations:

+ A computer industry with its ear to the ground for potential user needs. It will undoubtedly unearth undreamed-of demands for new computer applications.

+ A market for computer products dominated by a "purchase only" philosophy. It will be easier for companies to thrive on autotransaction without digging in for a long haul ... or looking for rental-base funding in times of low Wall Street interest.

+ The barriers between products and services in the industry will be demolished. Already turnkey system manufacturers see services as their biggest competitors. As autotransaction develops, the implications of this potential trade-off will be exploited by both sides of the competitive equation.

All of this is pretty philosophical, but that's all-the-more reason why autotransaction deserves notice; the transformation has already begun.

EMPLOYMENT

If statistics on the computer industry in general are less than readily available, data about employment -- by product and service supplier as well as by users of "computer product" -- is little more than an educated guess.

The American Federation of Information Processing Societies has begun to collect such data. In fact, IDC understands that AFIPS is about to publish an extensive study -- based on U.S. Census data and Bureau of Labor statistics among other things -- that will show that employment by manufacturers of computer equipment and suppliers of computer services in the United States was at approximately the 350,000 level for 1973. In addition, the AFIPS report is expected to indicate that employment by users -- the data processing managers, systems analysts, programmers, and key entry/keypunch operators -- is somewhat under one million. And historical data, according to AFIPS, is "lousy," although the biggest growth came in the 1964-1968 time period, with stable, relatively minor growth following the recession of the early 1970s.

AFIPS points out, additionally, that to the one and one-fourth million jobs thus created by the demand for computers must be added the unknown and growing number of people who use computers on a less-than-full time basis. This includes such people as scientists and stock brokers who use timesharing services, corporate planning and operations personnel who have responsibility for many areas of their company's activities but who don't show up in computer employment statistics. In the future, this category might include such people as bank tellers and department store clerks.

IDC collects sample data on spending for employees, and these figures are presented in the section on user spending. Another way IDC has begun to review each of the major computer system manufacturers is to calculate and analyze their net sales per employee. Unfortunately, detailed data for a company's "computer-related" activities is not readily available -- and historical data has not been analyzed. Published material indicates the following employment growth for the seven major computer system manufacturers, all of which derive a considerable portion of their revenue from the provision of computer hardware and services. (Note that historical figures for GE and RCA -- whose computer operations have been taken over by HIS and Sperry Univac respectively -- are not included.):

TABLE 133
EMPLOYMENT BY MAJOR SYSTEMS MANUFACTURERS
(000 omitted)

	1963	1968	1973
IBM -- U.S.	89.0		151.0
World Trade	49.0		123.1
Total	138.0	241.0	274.1
Honeywell -- HIS			47.0 (e)
All Other			51.1
Total	48.6	74.5	98.1
Sperry Rand	90.0 (e)	101.0	91.3
NCR	65.0	103.0	81.0
Burroughs	33.0 (e)	45.0	47.3
Control Data	4.0 (e)	23.4	36.5 (e)
Digital Equipment Corp.		4.0 (e)	12.9
TOTALS	378.6	591.9	641.2

For the 1972-1973 time period, IDC has used the above and comparable data to calculate net sales, or productivity, per employee. Major observations are:

+ IBM: Employs ovet a quarter million people worldwide and enjoys the highest yield per employee -- $40,100 as opposed an average of $31,100 for the sum of the seven companies under review (or $24,300 excluding IBM). Productivity for its World Trade organization is higher ($41,800) than in the U.S. ($38,700). In 1973, IBM increased sales by 15% with only a 5% increase in employment.

+ Honeywell: Employs just under 100,000 people -- just under half of which are in Honeywell Information Systems (HIS). Productivity for HIS is $25,000 per person.

+ Sperry Rand: Raised its index from $21,300 in 1972 to $24,400 in 1973.

+ NCR: Showed the highest rate of gain (29%) by decreasing employment 10% during 1973 (as it phased out production of mechanical cash registers) and increased sales 17%. Its index of $22,400, however, is still one of the lowest.

+ Burroughs: Has the third highest index ($27,200).

+ CDC: Employment figures are estimated to exclude its Commercial Credit operation but do include the largest service operation of any mainframer. The index of $26,000 is above the non-IBM average.

+ DEC: This was the only company to decrease its index in 1973 as employment increased early in the year. IDC estimates that in the company's fiscal year ended in June 1974 that DEC will have shown a reversal, with the index increasing from $20,500 to near the 1973 average.

INTERNATIONAL COMPUTER MARKETPLACE

Most of this submission has dealt with U.S. computers and how they are used in the U.S. marketplace. As Chart 131 vividly demonstrates, U.S.-based manufacturers not only supply the complete needs of U.S. users (who account for 55% of all computers used in the non-communist marketplace); they supply just over three-fourths the rest of this market, thus accounting for 90% of these computers.

But there is great pressure throughout the world to take advantage of the computer, as well as much nationalistic pressure to support a local computer manufacturer. As a result, growth rates of installed base outside the U.S. are expected to be about 16% a year -- some three or four points higher than here -- until 1978.

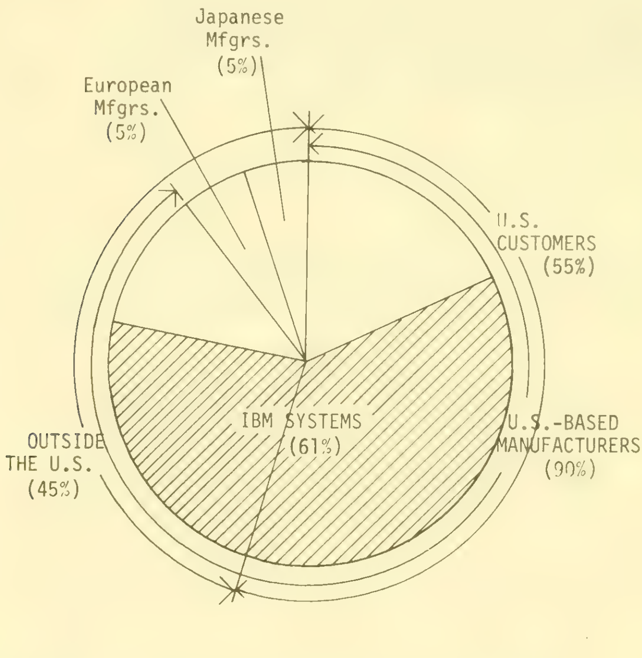


CHART 134 : DISTRIBUTION OF $50 BILLION OF COMPUTERS INSTALLED IN THE NON-COMMUNIST MARKETPLACE

To assist people in examining the relative growth potential for various countries throughout the world, IDC calculates a ratio between a nation's Gross National Product and the installed value of its computers. Then by comparison of this ratio with that of various other countries, at least one indication is available.

TABLE 135 : COMPARISON OF GNP TO VALUE OF COMPUTERS

	12/73-$M Inst. Base	1972-$B GNP (a)	EDP-% GNP
Japan	4,922	341	1.44
W. Germany	3,772	292	1.29
United Kingdom	3,231	152	2.13
France	3,012	221	1.36
USSR	2,195	549	0.40
Canada	1,530	103	1.48
Italy	1,329	118	1.13
Australia	643	52.7	1.22
Netherlands	642	50.0	1.28
Switzerland	579	35.6	1.63
Sweden	459	43.7	1.05
Denmark	388	22.7	1.71
Belgium	338	38.8	0.87
Brazil	330	49.8	0.66
Spain	324	50.7	0.64
So. Africa	233	19.1	1.22
Austria	181	22.8	0.79
Mexico	150	39.6	0.38
Norway	143	16.2	0.88
Yugoslavia	135	23.7	0.57
All Other International	1,475	942	0.16
Total International	26,011	3,184	0.82
United States	29,942	1,155	2.59
Worldwide Total	55,953	4,339	1.29

(a) U.S. Dept. of State, Bureau of Intelligence & Research

Senator HART. Our final witness today will be Mr. Robert E. Wallace, division vice president of Auerbach Associates.

Mr. Wallace, I apologize that you have been kept waiting so long. The subcommittee looks forward to hearing your testimony.

STATEMENT OF ROBERT E. WALLACE, VICE PRESIDENT, COMMERCIAL INDUSTRIAL DIVISION, AUERBACH ASSOCIATES, PHILADELPHIA, PA.

Mr. WALLACE. Thank you very much, Senator Hart. I didn't mind waiting at all. As the last speaker, one always finds that many of the things that he had in his material have already been said, so I hope you will bear with me while I sift through and find out what pieces of mine have not already been said.

Senator HART. Just to protect against oversight, we will order printed in the record in full your prepared testimony.

Mr. WALLACE. Thank you.

[Mr. Wallace's prepared statement appears as exhibit 1 at the end of his oral testimony.]

Mr. WALLACE. My remarks are addressed primarily to the structure of the supplier industry and in particular its major segment, which I will define a little later, to the present competition in that segment, and expectations for future competition—again, in that major segment of the market.

I do have a few observations on future industry directions. They are a little bit different than some of the ones that have been presented.

By the way, I should say that in all of the technical matters that have been presented today, and in the important features of the market data, our data are within gunshot of the same observations on both the technology and the market characteristics that were presented by the other speakers.

Auerbach Associates has been in the computer business since 1957. Since that time we have been deeply involved in providing consulting assistance, both to the manufacturers and to the users of computer equipment.

At the moment Auerbach supports the computer business by the publishing of technical reference services and as a consultant to both manufacturers and users.

We serve the suppliers of equipment as both technical consultants and as product and market planning specialists, and we serve users as consultants of all kinds designed to improve the effectiveness of the use with their computer systems.

These activities keep us pretty closely in touch with the policies, practices, and products of the various manufacturers on a day-to-day basis, and keep us in touch with many of the users on an ongoing basis.

If you need any further indication that you are dealing with an important industry, I think the information provided by the last speaker should convince you.

By our guess there are about 200,000 computers at work in the country today, counting some that are not counted in the IDC study, in the military, for example. This year, probably more than $25 billion will be spent on their use. About a million and a half people are directly involved, by our estimates, in the computer industry hour by hour.

There is something in it for everyone. If you think about some of the applications we have talked about today, the rich man's margin calls are made by computer, and the poor man's welfare eligibility is calculated by computer, and all the way in between there are activities that affect all of us.

Not dwelt upon as much as I think it might have been is the fact that in industry and commerce computers have become a necessity, because they have established a level of control over inventory, costs, and analysis of sales that has greatly raised the level of sophistication that is required of managers in those activities in practically every market for capital and consumer goods. You just must be able to use this technology in order to compete effectively today.

Senator HART. Maybe we will be told later, but to what extent do students in schools have instruction in the use of computers?

Mr. WALLACE. There are places where rudimentary computer instruction is going down to the grade school level. In our local school system—I am a resident of suburban Philadelphia—there are computer concepts courses regularly taught to junior high school students, and a number of senior high school students who express interest in it are actually taught. My own son took a half-year course in which he was exposed—and I must call it exposed, because no one could learn it—to something like five or six different fundamental programing languages in a matter of half a year.

So, the concepts are being put across at the schoolchild level, and the students are also involved in the sense that very many of the scoring and attendance systems are being administered by computers.

Children are being put in touch with computers at a very early age.

The remarks that I have made bear primarily on the economy. In the society generally, and on our way of life, the impact of the computer has been a little less direct so far, but I would like to mention just a couple things that haven't been mentioned so far.

First of all, there are a lot less routine clerical jobs in the economy than there would have been without the computer. I think someone remarked earlier there are not enough young ladies in the world to handle the clerical tasks that are being handled regularly by computers today.

Second, the computer seems to have standardized and made less personal many of the customer-supplier and citizen-government relationships that previously existed. I think all of us feel frustration every once in awhile when we are told that the computer did it, or it is its fault, and we really can't get satisfaction from Sally the bookkeeper or whoever we would like to talk to.

And, of course, I don't need to mention here that today so much information about the daily lives of citizens is in data banks and computers that it has raised serious questions about the right to privacy, and many people including our Vice President seem to be on a very strong course of assuring that privacy exists when these computer data banks become operative.

Until recently, though, the involvement of ordinary citizens with the computer has usually been secondhand. The arrival of hand-held calculators, which all of us have seen, that are selling for $29 retail indicates the impact on everyday life to be expected in the future, from the very inexpensive computers that are now becoming available.

There are devices—and I think you probably saw some of them today—that are worthy of the name computer that you can buy for $75 in quantity today.

Simple computers are already at work in our automobiles, and it will be only a short time until they are in use in our homes.

In a paper that Isaac Auerbach, our president, recently presented in Australia, Mr. Auerbach has compared the development of these low-cost computers to the development of the fractional horsepower motor, and predicts that the computer will have as profound an effect on our society as the ubiquitous fractional horsepower motor has had.

I don't know whether you have ever tried it, Senator, but some day when you have nothing better to do see if you can count how many fractional motors you have between one automobile and your home. You will be surprised; it comes out to be dozens. They are there, and we don't even notice them. It is our feeling that that will be the same with computers in only a few years.

So computers are already an important factor in the economy, but not said here so far today is that only about 1 percent of all the business establishments in the United States currently use computer services, and many of them use them in only very simple ways.

Furthermore, computers have not yet begun to be used in the home. So the final impact is still way, way ahead of us.

There are a couple of items about where these devices came from that haven't been mentioned. As a Philadelphian I would be remiss if I didn't remind everyone here that the first one of these gadgets that was a real one was probably built at the Moore School of the University of Pennsylvania by Presper Eckert and John Mauchly. They formed a company comprising their names and built the first Univac I in Philadelphia in 1951, the Univac I that you have heard referred to here before.

As a previous speaker said, there were responsible predicators who said that certainly not more than 50 of these would be useful. But it was suddenly recognized that the computer was a logical extension to the punched-card machines that were long marketed by IBM, Remington Rand, and others.

The computer, then, became a necessary successor product to IBM and to Remington Rand, but since it was an electronic device practically every major electronic firm in the country plunged into the business.

There were a number of combinations, acquisitions, internal developments, and joint ventures that formed the founding elements of the present competitors by the mid-1950's.

In the late 1950's the transition to transistors was made, and you have been taken through the evolution from transistors to the present integrated circuits and all of the improvements that this has produced in the computer business.

Just a word on where these developments came from. In the electronics business at that time there was a coalescing of a lot of demands. The space program gets credit in some quarters; certainly the computer business had something to do with it, the entertainment electronics business—all of these were contributers to the semiconductor industry—that is, the manufacturers of transistors—which helped

them continue to improve their product, reduce its size, and get to the point where they can make products of the sort that you saw today.

So, while we are talking about computers I think we should recognize that these developments have not only come from the computer industry, but have come from several other areas of the electronic industry as well.

Today the sorts of things that you say are being used to build devices called microcomputers—at least, that is what we refer to them as and so do some of their manufacturers. Those are the kinds of things we should expect to have contribute to the ubiquitous use that is referred to in Mr. Auerbach's paper, in the future.

I think you have already heard that the computer market is comprised of many segments. I want to mention it only to point out that my comments from here forward are primarily directed to one segment of the market for computer equipment which is actually acquired by the user. And by acquired, I don't mean purchased. I mean the use of which on his premises is paid for in some form by the purchaser.

Since the most pertinent monopoly issues so far have been raised in the full scale general purpose computer systems market segment, the balance of my testimony is directed to that segment.

Now, what is the definition of that?

You have heard all sorts of definitions of market segmentation today. I will make my own at the moment, and say that I am referring generally to computers which are put out in the marketplace for general use which the user uses to do many different things and which generally have a purchase price—new—of $100,000 or more.

The supplier industry that serves this segment of the market is basically the one to which you have been introduced already by IDC, and our estimates are not very different from theirs, I don't think, in terms of the market share and the vagaries of measuring both market share and earnings in this business. We all have the same difficulty, and we all understand that we have the same difficulty. I am not going to bother repeating ours here because I think they are well within gunshot of the observations that IDC made. While we are dwelling on the U.S. computer market, I want to emphasize again, however, that it is important that we note that the revenues and profits of these companies are derived only partly from U.S. operations.

Much of it comes from overseas. IBM, for example, last year as a company obtained more than half its revenue and more than half its profits from overseas operations.

We would judge that in the aggregate, probably a third of the revenue of the other U.S. manufacturers of computers in this class came from overseas sales and leases.

You have already been told, I think, that American firms dominate the market for machines in the class worldwide, or at least in Western Europe where they have been primarily adopted.

Interestingly enough, IBM's market share is not very different from that which it is in the United States. In any part of the free world, where there is reasonably free competition allowed by the political structure in that nation—and there are some exceptions to that, and where there are those exceptions IBM's share is less than it is locally—but practically everywhere that they have been able to compete, they hold a share equal to what they hold in the United States, and in some cases more.

The foreign market for computers, dominated by U.S. suppliers, has for several years been the fastest growing segment, and it is expected to remain so for the foreseeable future.

I want to now turn to something that I have called the total service concept. I think you gentlemen are looking at some capital goods industries. Many capital goods industries generate a very close relationship between suppliers and users of equipment, but none of them seem to have generated any greater degree of cooperation between the supplier and the user than that which exists in the computer field.

Much of this pattern was adopted from the punched-card business in which companies such as IBM and Remington Rand had developed a highly service-oriented combination of products and services long before the advent of computers.

The computer with its need for a high degree of specific knowledge and expertise in installation, maintenance and programing seems to have heightened the desire of the full service concept of user support by suppliers.

As the sophistication, particularly the sophistication of computer programing, has increased, this desire has become stronger until today literally everyone in the computer business is providing a combination of equipment and services to its users.

This close cooperation develops a following, or a brand association, in the specific user for what he believes is the most compatible and useful combination of products and services suitable to his own use.

That brand association also serves as a powerful stimulus to the provision of customer satisfaction by the various suppliers.

In recent years the market for the larger computers in this class has been primarily a replacement and upgrade market rather than the forming of new associations with first-time users of computers. Perhaps as much as 90 percent of the dollar value of the product delivered in recent years in the United States has either replaced or augmented computers already in use. Satisfied present customers, therefore, represent the largest market for additional revenue.

In addition to product characteristics and services provided, a great deal of the attitude of users is based on a kind of charisma about the supplier. His intent to remain in the business long term; the direction of his product and service orientation, and the apparent technical capability of his organization as determined by day-to-day contacts with his various sales, maintenance, and technical support personnel.

From the point of view of the supplier this charisma is extremely important. It represents the franchise on his present market share, and it is an important contributor to his expectation of any increase in market share.

I would like to then dwell for a moment on the ingredients of success in this business for the supplier. Now I am looking at it from the user's point of view. What does a supplier have to have in order to convince me, as a user, that I ought to do business with him?

The closeness of relationship that I have mentioned here between supplier and user and the tendency for many computer systems to be leased rather than purchased places stringent demands on the organization which aims to succeed and continue to succeed in the computer systems business.

First, he must have the necessary ingredients—desirable product characteristics, high product quality, and competitive prices; they are all a necessity.

Next, the charisma that I noted earlier must be satisfied. In order to do these things the succesful supplier of computer systems must engage in a very high level of research and development activity.

This activity must be applied not only to the equipment, but to software, the complex computer programs that are provided by the supplier to enable the user to get the most out of his system.

While research and development work on the computer equipment was the most important part of this activity for some time, more recently research and development on software has become most important to the user, since the potential performance of the computer system has been improved to the point that the ability of the user to make use of it is limited by software rather than by hardware characteristics.

Today, to hold a franchise in the computer systems market, a supplier must spend enormous sums of money and engage very sophisticated professional talent to develop and train users in the use of his software offerings.

Selections of computer suppliers by users are now often made on the basis of software characteristics rather than on equipment characteristics.

Once a supplier has fulfilled these requirements he needs large amounts of money to finance the equipment that is leased from him by his users and he needs specialized financial skills to understand the financial implications of a mixed sale-lease business. I think the previous speaker made that quite clear to you.

And last, he needs a large installed base of systems in the hands of customers to support the extensive maintenance and technical support services demanded by the total service concept.

Attempts have been made to break up this package of services traditionally provided by the computer system supplier, and some of these attempts have been successful.

Today, after all, when peripheral devices are obtained from independent suppliers, you must make some kind of a maintenance arrangement with that supplier or with an independent computer maintenance company.

A growing amount of software, developed by firms which do not supply computer systems, is being acquired by users, and independent consultants and programing firms are employed to augment or replace the services that are offered by the computer systems supplier.

These are a couple of examples of penetration of this package, concepts that are already in place. While these businesses have been moderately successful on a very small scale they do represent a potential source of competition for at least some portions of the total service traditionally provided by the computer system suppliers.

The largest group of users that we contact, however, still appears to wish to retain a single point of responsibility for computer equipment, software, and maintenance, to avoid the necessity to determine for themselves whether equipment failure, faulty maintenance, or faulty software has caused his system to fail.

Further separation of these services from the supply of the product—absent legislation—is a feasible course in many cases, but a considerable economic or service advantage must be provided to convince the large body of users that the resulting dilution of responsibility for the total service is worthwhile.

Now, I would like to turn to aspects of competition as they exist presently. By any measure it is clear that IBM holds the major share of this market. That, obviously, raises the question, are the firms now in the market—and I am speaking of computer system suppliers—a strong enough force to operate as effective competition for IBM?

At the moment it would appear that the computer system suppliers are not very effective. After all, a market in which the second place supplier has about 15 percent of the volume of the largest, hardly qualifies even as an oligopoly, and the two firms who hold the second position were helped to that market share by recent acquisitions of other firms who were leaving the business.

More effective competition of a different sort seems to have been provided by the plug-compatible peripheral equipment suppliers. I think you understand by now what plug-compatible peripheral equipment is and why it is there.

What may not have been said is that as computers have developed, increasingly the investment in computers has swung in favor of peripheral equipment. I don't know of any large system user today that I can think of who doesn't spend more money on peripheral equipment than he does on his main frame.

Now, I am sure that somebody can cite an exception or two, but I have even challenged a few of our user clients themselves to analyze their own bills, and had them come back and say, "Hey, you know, you are right. I didn't think about it, but that's the way it is."

But a number of companies have marketed this equipment, which is directly interchangeable with IBM products and could replace the IBM equivalent by simply unplugging the IBM product and plugging in the competing product. And, of course, that is where the name "plugcompatible" came from.

There is an important observation to make at this point, however. Practically without exception these devices are substitutable in IBM systems without changing the software. That is one of the reasons that they have had the kind of user success that they have had.

You simply plug in memory, you plug in tape, you plug in disk. These equipments are designed in such a way that they are not only able to be plugged into IBM sockets, but they also operate under the umbrella of IBM software, and nobody has to make any changes. Clients of ours have, in fact, removed IBM tapes, put in independent peripheral supplier's equipment, not liked them, taken them out, and put back in IBM. There are all sorts of combinations of that sort going on, because it operates entirely under the umbrella of the software that is supplied by IBM. That is the sacrosanct part, nobody touches that. Anything you can do without modifying the software is fine. If it is economic, I will try it. But when you get to modifying with the software it becomes a very different problem.

While these companies are relatively small by standards of the principal computer systems competition, they concentrated on the market for only one or a very few specific peripheral device products, and they

have been a more effective competitive force to IBM in these smaller market segments than have any one of the principal computer system suppliers in the overall systems market.

But the efforts of these competitors have resulted in IBM's reducing prices, improving equipment performance for the same price, and developing more advantageous leasing terms for equipment.

Clearly, then, competition, when it becomes noticeable, influences the larger supplier to offer more advantageous terms to users. So I believe that more effective competition by the competing computer systems suppliers, so that at least two of them have 20 or 30 percent of the market apiece, would result in better value for the user, and it should be encouraged for the long-term benefit of the industry.

But the largest supplier in this business, in my observation, holds his market share through the free choice of the computer users. These users must be persuaded that a new supplier will give them a better deal.

The sole restraint on expansion in the industry appears to be the cost and risk of obtaining a more significant market share.

For any of the present competitors to obtain a more meaningful market share will require a minimum investment of literally several billions of dollars, much of it at high risk, and a return to unprofitable operation for several years.

In addition, it will require outstanding equipment and software and incredible evidence that he is committed to build and maintain that market share by matching, or hopefully exceeding, the service and technical support that is provided by IBM.

Such a feat is not impossible, but at least two of the largest industrial firms in the country—I am referring to GE and RCA—have found it too much to contemplate within the last couple of years, and any others who try it have certainly got to find forebearing investors who are willing to take the long view. Despite this difficulty, I think what we have heard about the expansion of the industry would indicate that the potential reward is enormous, and I can only hope that to improve the value to the user, several organizations will see the reward and will somehow find a way to make the necessary effort.

There are a few observations that I have on the subject of trends in computer use. They are a little different from the ones that were made earlier.

First, we have heard about networking computers and things of that sort, but I think we ought to recognize that two conflicting trends are really apparent in the market for systems of this size.

The first and the oldest one is a trend toward centralizing the data processing resources of an organization into a large center designed to perform data processing work on an efficient computer system which is designed to do many jobs simultaneously.

That is about where we are. That is where these larger systems come from today. In connection with this trend, input data preparation—keypunching, if you will—is being removed as a function of the data processing center and is more and more being performed by the data processing center's users—and here I mean the accounting department, the manufacturing department, or the branches of an agency in government—and coupled to the central computer site by communications lines.

This centralization was undertaken in the belief that large computer centers exhibited a considerable increasing efficiency with size.

While there has always been an increasing efficiency with the size of computers, the margin over small computers has shrunk in recent years as inexpensive computers, and particularly the inexpensive peripheral devices associated with them, have become available.

This trend toward centralization of computer resources has run counter to a basic management philosophy of many organizations toward decentralization of authority and responsibility to obtain more effectiveness in their organization.

The centralization of computer resource in opposition to their basic organizational philosophy was justified as a necessary step to improve efficiency.

With the prospect of improved efficiency in smaller computers, however, many top managements are responding to the requests of subsidiary managers to operate their own computer systems in direct opposition to the computer centralization trend still evident.

Nobody expects the larger computer centers to disappear, but in many organizations we expect to see a leveling off in the growth rate of the larger centers and the displacement of some of their functions by smaller, less complicated computers coupled together in a network with each other and with the large central computers.

The distribution of input data preparation to the users and the use of networks of smaller computers both will increase the use of electrical communications to transmit computer data.

Data communications, probably the fastest growing segment of the computer field, has already raised serious public policy issues not yet completely resolved by the Federal Communications Commission and the State communications regulatory bodies.

The problem is that the extensive telephone communications network in place in the United States and most of the rest of the world can be used to transmit computer data, but it was designed for an entirely different purpose, and it is quite inefficient and expensive for data communications use.

Despite its high cost, however, computer users have already found it effective for many years to couple computers to communication lines to perform their work.

If data communications were less expensive it would be used much more extensively. This had led the Federal Communications Commission to conclude that competition rather than controlled monopoly should be encouraged to drive down the cost and improve performance of data communications.

The results so far have been encouraging. Data communications costs seem headed for a 50-percent reduction quickly, and more later.

Even at present communication costs, as many as 75 percent of the larger computer systems now being delivered are equipped to use some kind of data communication facility.

The expected availability of inexpensive means of data communication has led to this conception of computer networking that you have heard so much about here today.

Networks which operate this way are already in use in law enforcement and credit validation, to name a couple. The national banking system is headed toward it in order to handle money transactions.

So far, the revenue to communications carriers from this source, that is from computer users to communications carriers, is only about 3—or, I think, IDC says 4—percent of the cost of operating computers. It is probably a roughly equal proportion of the income of the communication carriers. So far, it is not large.

The impact of data communication used in conjunction with computers is growing at a very rapid rate, however. It is my estimate that it will at least triple in the next 5 years, which would require that it grow about twice as fast as the total market for computers.

The volumes of data transmission that this growth will generate will be adequate to support specialized data communication services to most locations in the country.

We can expect to see the development of these communication services proceed at a rapid pace to match the needs of computer users.

I beg the question of who will develop them, but that is a question for the FCC. One of the interesting features of this new form of distributed computing is the real possibility, however—already demonstrated—that large numbers of computers built by various suppliers may be connected together through data communications networks.

This development should serve to permit a wider choice by users from among the several suppliers with less difficulty than they now encounter in changing suppliers for large computers, and thus provide a spur to competition in this new and growing segment of the business.

As a closing remark, it is obvious from earlier speakers that computer technology continues to improve the price performance of computing equipment, and we expect that trend to continue. I would like to underscore, however, again, that the most costly part of computer use is the people. There are people that prepare programs, people that operate equipment, and people who prepare input data.

You have seen some evidence of the work that has gone on in the data input field. The game there is to eliminate input data preparation as a human function and take input data from the transaction.

There are other developments afoot that will reduce the work of the operator of computers.

But in the expensive activity of preparing computer programs, the key to improved effectiveness and efficiency is the development of improved software aids for computer programers.

Really, the objective in programing aids is to eliminate the programer entirely. There is no fundamental reason, even now, why the person who is able to describe the problem to be solved and to postulate the procedure to be used in solving it—and I refer here to the systems analyst or the user of the computer service—should have to learn a foreign language which is understood by the computer.

The user should be able to describe the problem and the procedure in language familiar to him and let the computer make the translation. In relatively crude form, I think you have heard already today, such aids presently exist. But ultimately, we are looking toward the programer—I shouldn't call him the programer, but the man with the problem—being able to communicate the problem to the computer literally by speaking to it rather than by putting instructions in writing.

Work to reach this objective is proceeding in a number of locations. I wouldn't want to say that a clearcut answer is at hand. Also, looking

back at the rate at which developments of this sort have caught hold, I guess we are talking about the mid-1980's.

But the fact that it is even feasible to consider such a solution, I think, serves to underscore the fact that computer technology and applications are only now beginning to be developed, and there is still a very long way to go before we find out where the end is.

Senator HART. The mid-1980's sounds pretty close for almost an unbelievable feat.

Mr. WALLACE. In 1958 I was employed at RCA, which was then in the computer business, and I was trying to convince our management that if we didn't have good, solid data communications products in 2 years we were really going to be out of the market. It is now 1974, and you see they are now coming. So, these things do take time.

Senator HART. The staff has developed a number of questions.

Mr. NASH. Toward the end of your statement, Mr. Wallace you talk about trends in computer use. You say that you expect to see a leveling off in the growth rate of large centers and displacement of their functions by smaller, less complicated computers coupled together in a network with larger central computers.

You referred to that again a moment ago. Given that prognostication of the future, we would be interested in your reaction—if you have one—to the significance of IBM's acquisition of a significant share of CML, the domestic satellite subsidiary of Comsat.

Mr. WALLACE. Well, I haven't really thought much about it. It is a fairly new development. It certainly does show promise to raise other questions concerning integration of communications and computers, which is a subject which the FCC spent some years trying to untangle and has only recently been able to even make utterances on.

IBM's anounced policy was that it was going to hold this property long enough to get it going and then withdraw, as I recall it.

The simultaneous ownership of a communications common carrier and a computer company of the magnitude of IBM would raise serious questions that would be clearly inconsistent with the policy presently in force by the FCC to try to separate these controlled and uncontrolled segments of quasi-communications activities.

I think you are probably familiar with their distinction. That is a long way from being finally adjudicated yet. This seems to fly directly into the face of that, if they are, in fact, integrated into networks.

Mr. NASH. From an industry structure, if technology is moving toward communication orientation with respect to data transmission and networks of computers, do you view control of a communications network as a requirement to perpetuate, say, present market shares by computer companies?

Mr. WALLACE. No, I don't think so. While we are talking about these things like they are in the future, there are in fact a number of these networks already in operation. Practically every major timesharing company has a network of this kind of its own. General Electric has one that is worldwide, for example.

I came from the communications industry, and I am in favor of a clean interface, as they say, between communications facilities and the communicants. I think that it has been achieved. It is necessary, really, in order to intercommunicate, for example, between different computers, that you get some kind of a commonality between them in the

communications medium. But I don't think it is necessary, nor do I think it is desirable, for computer companies to acquire control over the communications facilities that are used to interconnect these networks.

Mr. NASH. The other point I would like to touch on relates to your comments respecting problems confronting the computer companies trying to increase their market share. I think you put two values to that, the capital requirements due to the leasing nature of the business, and second, the total service concept, putting in charisma or brand loyalty.

Thinking out loud, assuming there would be adopted a national policy of promoting more competition in the computer industry, I would be interested in your reaction to the feasibility of some restructuring along the following lines.

One possibility I heard about relates to separating out of the total service concept, so we have main-frame manufacturers barred from servicing or maintaining the equipment. It has been argued this would sort of break the lock of dependence on the manufacturers and better equipment would then be purchased by the user.

Would such an approach, in your opinion, be feasible?

Mr. WALLACE. Back to your earliest observation, I did describe two barriers; and you added something to one: a caveat that said, "due to the leasing nature of the business." That is only part of it.

The capital barrier comes in many other forms—research and development, marketing, geographic distribution of both the technical support services and the maintenance services.

To go to your question, I think your question is, is it feasible to separate purely equipment maintenance activity? I think the answer to that has to be: Of course, because it is already in existence, and it is being done today.

It is feasible. I don't know that it would be particularly rewarding. I think that IDC pointed out that something like 8 percent of the computer expenditures are for maintenance activities.

It is not maintenance that is the strickiest part of the total service concept. That is one piece of it, but all of the things that have to do with software maintenance—which is a very different thing than equipment maintenance—and technical support are probably a more significant factor to the user than just having someone come and replace a faulty board, for example.

Mr. NASH. I recognize that you are talking about an 8 percent element, but to the extent it is that after-sale contact which contributes to the user sticking to a particular company, would it not have more of an impact than you suggest?

Mr. WALLACE. It would have some impact, but the people whose continuing contact, I think, means as much as people who don't really fix the equipment, but are people who are the carriers of technical support and the sales representatives who keep reminding people about product improvements, changes, and things of that sort.

The maintenance people are there, and they fix the equipment. They deal with the people in the machine room, but they don't get as much of the management's attention as do these other people who are a part of the total service concept package.

Mr. NASH. I can think of one approach to lessen the capital barrier; namely, to bar manufacturing companies from leasing and require a

GMAC-type entity to lease all computer equipment, or just let independent leasing companies spring up. You indicated leasing is not the sole cause of the capital barrier.

Can you contribute any other ideas for thinking about what policies might be invoked to lessen the capital barrier?

Mr. WALLACE. Leasing costs are certainly not trivial. I didn't mean to toss them off as being trivial. They are simply not all of it.

The critical question in leasing is, Who takes the risk? While IDC pointed out that a number of people made out very well in the leasing business, it is also true that there are an awful lot of them who didn't make out well at all.

The manufacturer, prior to or in the absence of a third-party leasing organization, is the one who carries that risk. Laying it off is not a simple financial matter.

There is a risk involved, and someone has to pay—the manufacturer, specifically, who is laying off that risk—a premium for it. You describe a GMAC-type of realtionship. That GMAC relationship, or whatever equivalent you get, must be structured in such a way that it can handle the risk, otherwise, it is not performing the same function that the manufacturer performs. It is performing purely a channeling-of-funds kind of function, and there are plenty of those around today.

You certainly can find people who will arrange full pay-out leases based on the customer's prime credit, if all you are trying to do is to shove the risk on the customer without his laying out capital.

It is the risk-bearing function that the manufacturer now holds that is the thing that has to be assumed by somebody. That is the thing that the manufacturer's money is up for.

To answer the rest of your quesiton, I can think of a way in which the industry might be more completely separated, but I don't expect to live to see it; that is, by having some of the entities who create software be the entities who create the systems software that is now the province of the manufacturer.

I have been involved in investigations where people have seriously considered doing just that, and I am sure that somebody is sitting around seriously considering how to do it somewhere today.

It has a lot of difficulties; quite a few. When one designs a computer today, one generally starts with a description of the software and proceeds to design the computer from that point. So it is very intimately tied up with the conceptual process of a new product, and that is the thing that I think stands in the way of it.

But I want to convey as strongly as I can the impression that software is the toughest lock today, in my opinion, and I think that is echoed by several of our other speakers here today, in one form or another.

A user client of ours the other day said to me, "You can feel yourself being drawn in closer and closer, each time you adopt a new chunk of major software." You just feel it. There is absolutely nothing you can do about it. You don't necessarily deplore it, but you certainly can feel it, because of the investment that the user makes in training, data conversion, program conversion, and just general overall ache of getting onto some new piece of vendor-supplied software. It makes it almost unthinkable at major installations to change system suppliers just because of the trouble you would go through with the software.

Mr. NASH. Thank you very much.

Senator HART. Mr. Chumbris?

Mr. CHUMBRIS. Thank you very much, Mr. Chairman. I have no questions of the witness. He presented a document here. He has handled his questions well with Mr. Nash. I think it will be good for the record, for those who wish to examine closely not only your testimony, but the testimony of previous witnesses.

I am sure during the course of these hearings we will get reaction to all the testimony today.

Senator HART. I, too, think that the background you have given us will be helpful. It has been a strong background. Again, I thank you and apologize for holding you so long.

Mr. WALLACE. Quite all right.

Senator HART. We will adjourn to resume tomorrow morning at 10 in this room.

[Whereupon, at 6 p.m., the hearings were adjourned, to reconvene at 10 a.m., Wednesday, July 24, 1974, in room 2228, Dirksen Senate Office Building.]

[The following was received for the record:]

MATERIAL RELATING TO THE TESTIMONY OF ROBERT E. WALLACE

Exhibit 1.—*Prepared Statement of Mr. Wallace*

PREPARED STATEMENT OF ROBERT E. WALLACE, DIVISION VICE PRESIDENT, COMMERCIAL/INDUSTRIAL DIVISION, AUERBACH ASSOCIATES, INC., PHILADELPIA, PA.

THE STRUCTURE OF THE COMPUTER SYSTEMS INDUSTRY

AUERBACH CORPORATION

Auerbach Corporation was founded in 1957 by Isaac L. Auerbach, President, and a few associates. In 1957, these men were already veterans of the computer business; most of them are still employed by the Firm. Since its inception. Auerbach has been deeply involved in providing consulting counsel to both the manufacturers and the users of computers. Thus, the Firm has had excellent opportunities to view the industry both from the supplier and user points of view.

Auerbach now supports the computer business as a publisher of technical reference services and as a consulting firm. Both activities keep the Firm in constant touch with the products, policies, and practices of the principal suppliers and many of the users of computer equipment, on a day-to-day basis. The material you will hear today is drawn from our experience in these relationships.

IMPACT OF THE COMPUTER

Less than twenty-five years ago, the Electronic Digital Computer was a laboratory curiosity. Today it plays a part in the life of nearly every United States citizen. There are now more than 200,000 computers at work in the United States performing jobs as complex as guiding space vehicles; as basic as computing supermarket bills. This year more than $25 billion will be spent on their acquisition and use.

Computer activities in the United States employ about 1.5 million people; but there is scarcely a life which is not affected in some way as computers:

Process bank transactions,
Handle insurance premiums and claims,
Keep track of tax payments,
Control welfare and social security benefits,
Record stock and bond sales,
Make reservations for transportation and lodging, and
Administer credit files,

to name only a few of the uses of these new tools in everyday life.

In industry and commerce, computers have become a near-necessity as they have established a level of control over business inventories, costs, and analysis of sales that has greatly raised the level of sophistication required of businessmen to compete in virtually every market for capital and consumer goods.

The impact of the computer on society and on our way of life has so far been less evident than that on the economy but it has begun to make its mark:

There are far less routine clerical jobs in the economy than there would have been without the computer. For example, just prior to wide-spread adoption of the computer in insurance companies, the largest companies were developing attractive, low-cost apartment building "cities" in which young ladies could live in order to staff their steadily growing clerical operations. Today, a great deal of this work has been taken over by computers. There would not be enough women in the country to handle the present burden of their tasks in any other way.

The computer has standardized and made less personal many of the customer-supplier and citizen-government relationships which previously existed. Twenty years ago if you found a mistake in your bank statement, you could talk directly to the bookkeeping clerk about it. Today, there is no bookkeeping clerk and other, less personal means are utilized to investigate such matters.

Today, so much information about the daily lives of citizens is recorded in computer systems by government, industry, and commerce, that serious issues have been raised about the "right to privacy," or protection from unwarranted instrusion on the personal affairs of citizens.

These are only a few of the ways in which our economy and our society have so far been affected by computers. Until recently, the involvement of ordinary citizens with the computer has usually been only second-hand. But the arrival of hand-held calculators for as little as $29.00 indicates the impact on everyday life to be expected in the future from the very inexpensive computers now becoming available. Simple computers are already at work in our automobiles and it will be only a short time until they are in use in our homes. The potential uses of these devices in the home, in education, personal transportation, health care, and product distribution are discussed in the attached paper "The Information Revolution—Will It Improve The Quality Of Life" presented by Isaac L. Auerbach, President of AUERBACH Corporations, to the 6th Australian Computer Society Conference in Sydney, Australia this past May. In this paper, Mr. Auerbach compares the development of low-cost computers to that of the low-cost fractional horse-power motor and predicts that the computer will have as profound an effect on our society as the ubiquitous fractional horse-power motor has had.

Computers are already an important factor in our economy. But it is estimated that only about one percent of the business establishments in the United States currently use computer services, many of them only in simple ways, and computers have not yet begun to be used in the home. The final impact of the computer on society is still before us and many predict that the computer industry will eventually be the largest industry in the world.

A BRIEF HISTORY OF COMPUTERS

Scientists and engineers have long known how to build machines to perform mathematical operations and many have been built in the form of adding machines, bookkeeping machines, and specialized calculators. During World War II, means were conceived to build calculating devices many times faster than those in existence by using vacuum tubes to perform the calculations. While many others worked in the field, the first real digital computer is usually credited to J. Presper Eckert and John Mauchly, who built a computer called ENIAC at the Moore School of Electrical Engineering at the University of Pennsylvania. Eckert and Mauchly formed Eckert-Mauchly Computer Corporation, and in 1951, delivered the first commercial computer, the UNIVAC I.

It is interesting to note that at about this time, less than 25 years ago, serious evaluators predicted that perhaps as many as fifty computers, certainly no more, could conceivably be utilized in the U.S. economy.

Suddenly it was recognized that the electronic digital computer was the logical extension of the punched-card machines long marketed by IBM, Remington Rand, and others. It possessed the capability to replace the battalions of clerical workers then being organized to cope with the post-war expansion of clerical-intensive industries such as insurance and banking.

Thus, the computer became a necessary successor product to IBM and Remington Rand but it was, after all, electronic, and virtually every sizable electronic firm in the country plunged into the business.

IBM entered the business by building its own organization. In a series of acquisitions, including that of Eckert-Mauchly, Remington Rand built its initial capability, subsequently merging with Sperry Gyroscope to form Sperry-Rand, the present parent of the UNIVAC computer division.

Through combinations of acquisition, internal development, and joint ventures, the founding elements of the other present competitors were formed in the mid-1950's. In the late 1950's, engineering work had progressed to the point where transistors were being used to replace vacuum tubes in computers. The improved reliability and lower cost of transistor devices made much more extensive computer systems practical and transistors were universally adopted to build the "second-generation" of computer systems. At first, transistors simply replaced vacuum tubes in computers as they did in radios, television sets, and a wide variety of other electronic equipment. Scientists and engineers quickly devised many new forms of the transistor, or semiconductor, as it came to be called. The small size and low power consumption of semiconductors allowed them to be combined into small packages containing several such devices to perform a specific function. These devices, called integrated circuits, dramatically reduced the size, power requirements, and cost of computers, at the same time improving their speed of operation. The innovations which produced these dramatic improvements came from a wide variety of organizations both within and outside the computer industry, primarily from semiconductor manufacturers, who progressed from the manufacture of single, discrete transistors the size of a dime to the point where entire assemblies of semiconductors, for example the active computing elements of the hand-held calculator, are now deposited in a continuous process on a "chip" of about the same size. Improvements in this technology continue to be made and today techniques of large-scale integration of semiconductor devices are leading to even smaller, less expensive aggregations of electronic circuitry which are producing very sophisticated "microcomputers" which will form tht basis of the wide-spread use of computers referred to earlier.

MARKET SEGMENTATION

The computer market is comprised of many segments. Today, one can purchase or lease all or a part of a computer system from many different sources. In addition, the services of a computer may be obtained from firms which specialize in supplying such service, without the user's acquiring a computer. Computer programs, the instructions necessary to make use of the computer, may be obtained from independent sources.

In the market segment for computer equipment acquired by the user, a distinction is frequently drawn between the smaller machines, referred to as minicomputers, or small business computers, and the larger, more expensive full-scale general-purpose computers. To date, the largest dollar-volume of activity has been in the full-scale general-purpose computer, although there are now more minicomputers in use, their number is growing more rapidly, and they may eventually rival the larger computers in total dollar impact.

Since the most pertinent monopoly issues have been raised in the full-scale general-purpose computer systems market segment, the balance of this testimony is directed to that segment.

THE SUPPLIER INDUSTRY

In the U.S. there are six principal manufacturing entities now responsible for more than 95 percent of the served market for major computer systems. These entities share the market roughly as follows:

Supplier:	*Percent market served*
IBM	64
Honeywell	9–10
UNIVAC	9–10
Burroughs	4–5
Control Data (CDC)	4–5
National Cash Register (NCR)	3
Others	5

In 1973, AUERBACH estimates that the financial results of the computer operations of these entities were:

Company	Computer revenue (billion)	Computer profit (million)
IBM	$8.7	$1,200
Honeywell	1.2	93
Univac	1.2	71
Burroughs	.6	50
CDC [1]	.9	17
NCR	.3	<10

[1] CDC operates in a wide variety of computer service and peripheral equipment markets. While these are its total revenue figures, much of its income comes from these sources rather than from large-scale general-purpose systems.

The high degree of leasing employed in the industry makes these figures variable from company-to-company and from year-to-year. In addition, accounting practices vary with respect to deferred costs. Thus, both revenue and profit data are simply indicators of the relative impact on the market of each of the companies rather than a precise measure.

While we are dwelling here today on the U.S. computer market, it is important to note that the revenues and profits of these U.S. companies are derived only partly from U.S. operations; much of the income is derived from foreign operations. IBM, for example, last year obtained more than half its revenue and profits from overseas operations. In the aggregate, probably a third of the revenues of the other U.S. manufacturers of computers in this class are received from overseas sales and leases.

Furthermore, more than half the computer value, world-wide, is in use in the U.S., representing a much higher level of market saturation than elsewhere in the world. Thus, the foreign market for computers, which is dominated by U.S. suppliers, has been for several years the fastest growing segment and is expected to remain so far the foreseeable future.

COMPETITION

Clearly, the bulk of the business in this field in the United States is done by IBM. The same is true in every section of the world where government policy allows reasonably free competition. How did this come about?

In the pre-computer era, IBM had a strongly-entrenched position in the market for punched-card business equipment. In fact, before World War II, IBM had achieved a dominance of that business greater than it now enjoys in computer systems. That position was established for a long time on a very wide scale and it was maintained for many years by a combination of factors, including some found so inappropriate by the U.S. Government that IBM accepted several consent decrees which were designed to remove barriers to effective competition.

A constant ingredient, however, of maintaining that position was the existence of a very strong marketing establishment, and a policy of supplying an almost overwhelming amount of maintenance and technical support.

Between 1954 and 1964, IBM built its computer business and obtained a healthy market share. By 1964, however, competition, particularly from Honeywell, UNIVAC, and RCA began to siphon off noticeable amounts of its business. In 1964, IBM took the biggest gamble in its history by announcing System 360, a complete line of computer systems designed to obsolete virtually every computer in the IBM product line and to compete with practically every competitors computer. A singular feature of System 360 was a high degree of "upward mobility"—a computer user could obtain a relatively small computer and, as his workload increased, could move to a larger one without the need to redevelop computer programs, until then a difficult, costly burden for users who changed computers.

This bold stroke re-established IBM pre-eminence with the bulk of major users who were long-time punched-card equipment users and IBM's market share quickly passed 60 percent and has remained above that figure, fluctuating from time-to-time, ever since.

One of the most difficult and expensive features of System 360 was the provision of a set of computer programs known as an Operating System, which was designed to control the entire computer resource and all the jobs being done by the computer.

Operating Systems were not new, but one of the breadth and scope of the one proposed by IBM had never before been created. As a measure of how difficult a process the development of this feature was, the proposed single Operating Sys-

tem eventually became five or six different systems and many of the features proposed for the original system are only now coming into existence, ten years later.

The reactions of the principal competitors to this move by IBM varied. Burroughs and National Cash Register, who had previously supplied business machines to the financial and retail industries, carved their market shares largely in these fields. Honeywell, committed to across-the-board competition with IBM, released new products and went to work to develop an Operating System for them. RCA decided to build computers which could use the IBM Operating System and sell them for a lower price. General Electric and Control Data Corporation generally pursued courses which attempted to avoid head-to-head competition with IBM. In the early 1970's, RCA sold its installed base of computers to UNIVAC and General Electric placed its computer business in a new corporation, Honeywell Information Systems, majority-owned by Honeywell, and incorporating Honeywell's computer business. These moves created the competitive environment which exists today.

The question then arises "Are the firms now in the market a strong enough force to operate as effective competition for IBM?"

At the moment, it would appear that they are not very effective. A market in which the second-place supplier has about 15 percent of the volume of the largest hardly qualifies even as an oligopoly; and the two firms who share the second position were helped to that market share by recent acquisitions of other firms who were leaving the business.

More effective competition of a different sort has been provided by the plug-compatible peripheral equipment suppliers.

As computers have developed, increasing amounts of dollar expenditures have gone into the "peripheral" products-magnetic tape and disc mass memory, printers, and other equipment designed to store large amounts of information external to the computer itself and to handle the complex tasks of getting information into and out of the computer. Some years ago, companies not directly engaged in the computer system business, but with the capability to make these peripheral equipments, began marketing equipment which was directly interchangeable with IBM products and could replace the IBM equivalent by simply unplugging the IBM product and plugging in the competing product. Thus, the name "plug-compatible" was born.

Initially, these products were pretty much direct copies of the IBM product and the appeal to users was simply a lower cost than that from IBM. Eventually, however, several of these firms understood the technology well enough to introduce products with characteristics superior to those offered by IBM.

While these companies are relatively small by the standards of the principal computer system competition, they concentrated on the market for only one, or a few, specific peripheral device products and have been a more effective competitive force to IBM in these smaller market segments than have any of the principal computer systems suppliers in the overall systems market.

The efforts of these competitors have resulted in IBM's reducing prices, improving equipment performance for the same price, and developing more advantageous leasing terms for equipment.

Clearly, then, competition when it becomes strong enough influences the largest supplier to offer more advantageous terms to users.

More effective competition by the competing computer systems suppliers, so that at least two of them had 20–30 percent of the market each, would, I believe result in better value for the user and should be encouraged for the long-term benefit of the industry.

We are dealing here, however, with a situation in which the largest supplier holds his market share through the free choice of the computer users. Artificial restraints such as patent monopoly, tie-in sales, and restrictive practices have been stripped away in this market. The sole remaining restraint appears to be the cost and risk of obtaining a more significant share. For any of the present competitors to obtain a more meaningful market share will require, at minimum, investment of literally several billions of dollars, much of it at high risk, and a return to unprofitable operation for several years. In addition, it will require outstanding equipment and software and the contender must present credible evidence that he is committed to build and maintain that maket share by matching or exceeding the service and technical support provided by IBM.

While such a feat is not impossible, at least two of the largest industrial firms in the country have found it too much to contemplate and any others who try it must find forebearing investors who are willing to take the long view.

Regardless of the difficulty, the potential reward is enormous and I can only hope, for the sake of improving value to the user, that several organizations will see the reward and make the necessary effort.

PRODUCT INNOVATION BY IBM

Once a computer manufacturer has established a substantial lease base of computer systems which provide predictable revenue on a regular basis, the level of ultimate profitability of any given computer line depends in large part on the length of time over which revenue is received. The most profitable computer product is one that remains relatively stable and is not quickly displaced by products which demonstrate improved cost-performance characteristics. A manufacturer with a large base of computer revenue is, therefore, reluctant to introduce, prematurely, a new, more productive product which results from his research and development activities. The timing of the introducing of new products which may displace products producing lease revenue is one of the most critical factors in the business.

A holder of a small market share, who wishes to make a substantial investment to increase that share, is less reluctant to obsolete his own product in the marketplace than is the more dominant supplier, since he expects to divert present users of competitors' systems to his own. If UNIVAC, for example, could obtain 10 percent of IBM's market share, it would more than double its own share. On the other hand, if IBM were to obtain 10 percent of the UNIVAC market, its own market share would hardly be affected.

A smaller supplier can afford (and has more reason) to take higher risks by introducing new technology as quickly as it is available.

These factors make it tempting for a large supplier like IBM to hold back new developments from the marketplace until their introduction is made necessary by competitive pressure or the need for a new and different product to continue its own market growth.

In the history of the computer business, there is evidence that IBM has, on occasion, attempted to prolong product life by withholding new technology from the market. These attempts have often been short-lived because competitors have attempted to penetrate the market with improved technology and lower costs for equivalent performance. IBM's reaction to these moves has been to be tolerant to the point at which they believe their market share is substantially threatened, then to release new or revised products designed to restore or improve its previous competitive position.

On the other hand, IBM had advanced technology substantially in several fields. Their contributions to the improvement of magnetic storage technology, particularly that of disc storage, have been pioneering ones, as have their contributions in the general-purpose input-output device field.

There is a developing tendency toward the development of "packages" of computer systems and programs designed to fit specific needs, rather than continue to offer the "general-purpose" computer which is all things to all people. There are several significant elements of this new direction. First is the provision of specialized terminal devices which permit easy access to and from the computer by lay operators—department store clerks, supermarket clerks, and bank tellers, for example. In some cases, as with the automatic bank tellers now being installed, the customer himself communicates directly with the computer system. IBM seems to be taking a strong position in the development of these specialized systems, as indicated by their recent announcement of specialized systems for the banking and grocery retailing industries.

Thus, IBM is not always first with new product technology in all fields, but in specific fields it has been a leader and its product realization of whatever level of technology it decides to implement is rarely less than excellent.

THE TOTAL SERVICE CONCEPT

Many capital-goods industries generate a close relationship between suppliers and users of equipment which involve complicated combinations of providing the product, financing it, servicing it, making improvements, and assisting the user in applying it. But none seems to have generated the degree of cooperation between suppllier and user that exists in the computer field.

Much of the pattern of close relationship was adopted from the office-machine field, in which companies such as IBM and Remington Rand had developed a highly service-oriented combination of products and services long before the ad-

vent of computers. Until 1956, when it agreed to do so as a part of a consent decree in a suit by the U.S. Government, for example, IBM would not sell its punched-card equipment to users. Instead, IBM made the equipment and a host of services available to users for a fixed monthly charge. Title to equipment was never passed to the user.

The characteristics of the computer, with its need for a high degree of specific knowledge and expertise in installation, maintenance, and programming, heightened the desire for the "full-service" concept of user support by suppliers. As the sophistication, particularly of computer programming, has increased, this desire has become stronger until today everyone in the computer business is providing a combination of equipment and services to its users.

As one might expect, this close cooperation develops a "following" in a specific user for the most compatible and useful combination of products and services suitable to that user. Occasionally, the close relationship also causes users to become dissatisfied with the combination of products, service and people, and to change suppliers, or "migrate," from one supplier to another, seeking a more nearly optimum combination of product and service assistance. Thus, a high degree of "brand" association is developed, whether it be brand loyalty or brand suspicion, by the users of computers.

This brand association serves as a powerful stimulus to the provision of customer satisfaction by the various suppliers. In recent years, the market for computers in this class has been primarily a replacement market rather than the forming of new associations with first-time users of computers. Perhaps as much as 90 percent of the product delivered in recent years in the U.S. has replaced computers already in use. Satisfied present customers, therefore, represent the largest market for additional revenue.

In addition to the substantive matters of product characteristics and services provided, a great deal of the attitude of users is based on a kind of charisma about the supplier: his intent to remain in the business, long-term; the direction of his product and service orientation, and the apparent technical capability of his organization, as determined by day-to-day contacts with his various sales, maintenance, and technical support personnel.

From the point of view of the supplier, this charisma is extremely important. It represents his franchise on his present market share and is an important contributor to his expectation of increased market share. In short, it is a characteristic to be developed and retained at all costs. This is particularly true since the dramatic withdrawals from the market by General Electric and RCA Corporation in the past three years, after decades of participation, reminded users that the computer business is an expensive and quite risky one, requiring devotion of vast amounts of capital and top management attention for survival.

INGREDIENTS OF SUPPLIER SUCCESS

The closeness of relationship between supplier and user and the tendency for many computer systems to be leased rather than purchased, places many stringent demands on the organization which aims to succeed and continue to succeed in the computer systems business. First, as in any other major capital-goods business, desirable product characteristics, high-product quality, and competitive prices are a necessity. Next, the charisma requirement noted earlier must be satisfied. To satisfy these requirements, the successful supplier of computer systems must engage in a very high level of research and development activity. This activity must be applied not only to the equipment, but to "software," the very complex computer programs provided by the supplier to enable the user to get the most out of his computer. While research and development work on the computer equipment was the most important part of this activity for some time, more recently research and development on software has become the most important to the user, since the potential performance of the computer system has been improved to the point that the ability of the user to make use of it is limited by software rather than equipment characteristics. Today, to hold a franchise in the computer systems market, a supplier must spend enormous sums of money and engage very sophisticated professional talent to develop and train users in the use of his software offerings. Selections of computer suppliers by users are now often made on the basis of software characteristics rather than on equipment characteristics.

Once a supplier has fulfilled these requirements, he has need for large amounts of money to finance the equipment leased from him by his users, specialized financial skills to understand the financial implications of a mixed sale-lease

business and, finally, a large installed base of systems in the hands of customers to support the extensive maintenance and technical support services demanded by the total service concept.

Attempts have been made to break-apart this "package" of services traditionally provided by the computer system supplier and some of these have been successful. When peripheral devices are obtained from independent suppliers, maintenance arrangements with that supplier or with independent computer maintenance companies are required. A growing amount of software, developed by firms which do not supply computer systems, is being acquired by users, and independent consultants and programming firms are employed to augment or replace the services offered by the computer system supplier.

These businesses have been moderately successful on a fairly small scale to-date, but they represent a potential source of competition for at least some portions of the total service traditionally provided by the computer system suppliers.

The largest group of users, however, still appears to wish to retain a single point of responsibility for computer equipment, software and maintenance to avoid the necessity to determine for himself whether equipment failure, faulty maintenance or faulty software has caused his system to fail.

Further separation of these services from the supply of the product is a feasible course in many cases, but a considerable economic or service advantage must be provided to convince the large body of users that the resulting dilution of responsibility for the total service is worthwhile.

THE ATTITUDES OF USERS

The users of computer systems are not a homogeneous group. They fall naturally into four classes:

(1) The Very Sophisticated, Special-Application Users. This group, characterized by the Livermore Laboratories of the Atomic Energy Commission, generally select computer equipment which they, by their own tests, have determined to be best suited to their own use. Usually these organizations develop their own computer programs and, on occasion, they build specialized equipment themselves to augment the capabilities of the chosen computer equipment. They may even maintain it themselves. Such organizations avail themselves least of the services that accompany the usual computer adoption, preferring to supply the necessary expertise themselves. Such organizations are few in number but they tend to acquire the most sophisticated, expensive systems.

(2) Large, Sophisticated Users. Characterized by some of the major airlines, some major corporations and some departments of the federal government, these users make a great deal of use of the supplier-provided services but they are able to, and frequently do, combine equipment and services from a number of sources to best meet their needs. They are capable of providing, when necessary, or desirable, specialized equipment and specialized computer programs themselves to meet specific needs.

(3) Large, Less Sophisticated Users. These organizations, typified by most of the Fortune 500 industrials, large banks, insurance companies, transportation, and financial service companies, are large users of computers but they confine themselves primarily to the role of user. They depend on supplier-provided equipment and many computer programs, but retain quite sophisticated analysis staffs capable of evaluating which of the choices of equipment and computer programs is best for their particular need. These comprise the vast middle-ground of the market where the most money for computers is spent. They avail themselves of virtually all the supplier-provided services and are frequently quite dependent on the supplier organization to solve their most difficult problems and to help with the development of their sophisticated computer programs.

(4) Medium and Small Users. Numerically, these users are the largest group, although they do not use the largest dollar-value of computers. Typically, these users rely almost entirely on the equipment and services provided by the supplier and the pace of their adoption of computerized systems is controlled to a great extent by the suggestions made by the computer supplier. In implementing systems, they typically avail themselves of all the services of the supplier.

Thus, from the largest and most sophisticated users we see an increasing dependence on the supplier as we approach the smaller and less sophisticated.

The organizations of the several suppliers are structured to give the appropriate levels of support to the various classes of users. Although practically all serve some in each class, some of the companies specialize in serving one or another

class of user. In this case, the entire supplier organization is oriented to the principal class of user served.

Most users are quite satisfied with the support provided by their suppliers although, inevitably, annoying, and sometimes serious, deficiencies occur from time-to-time. Occasionally a poorly engineered porduct is placed into service and user complaints are general until the product is made to work properly, is withdrawn, or replaced.

Systems program, those provided by the supplier to control operation of the computer system, typically have a number of defects and inefficiencies at first introduction, but these are gradually identified and removed by the supplier, after which user satisfaction is generally restored.

Typically, the user spends nearly twice as much using his computer (for personnel and supplies) as he does to acquire it Thus, while computer price evaluations are important, they are not the most significant part of the cost of computer use and a 10 percent variation in price for performance judged to be equal might be more than offset by other considerations.

TRENDS IN COMPUTER USE

Two conflicting trends are now apparent in the use of computers of the type we are discussing here today. The first, and oldest, is a trend toward centralizing the data processing resources of an organization into a large center design to perform data processing work on an efficient computer system designed to do many jobs simultaneously. In connection with this trend, input data preparation (key punching) is being removed as a function of the data processing center and is, more and more, being performed by personnel in user organizations (accounting, manufacturing (etc.), coupled to the central computer site by communications lines.

The thrust toward centralization was undertaken in the belief that large computer centers exhibited a considerable increasing efficiency with size. While there has always been an increasing efficiency with size of computer, the margin over small computers has shrunk in recent years as inexpensive computers, and particularly the peripheral devices (auxiliary memory, printers, etc.) associated with them, have become available.

The trend toward centralization of computer resources has run counter to the basic management philosophy of many organizations toward decentralization authority and responsibility to obtain more effectiveness. Centralization of the computer resource in opposition to basic organizational philosophy was justified as a necessary step to improve efficiency. With the prospect of improved efficiency in smaller computers, many top managements are responding to the requests of subsidiary managers to operate their own computer systems, in direct opposition to the computer centralization trend still evident.

No one expects the larger computer centers to disappear in favor of a network of smaller centers, but, in many organizations, we expect to see a leveling off in the growth rate of the larger centers and the displacement of some of their functions by smaller, less complicated computers, coupled together in a network with each other and with the larger central computers.

The distribution of input data preparation to the users and the use of networks of smaller computers both will increase the use of electrical communications means to transmit computer data. The use of data communications, probably the fastest growing segment of the computer field, has already raised serious public policy issues not yet completely resolved by the Federal Communications Commission and state communications regulatory bodies.

The extensive telephone communications network in place in the U.S. and most of the rest of the world can be used to transmit computer data but it was designed for an entirely different purpose and it is inefficient and expensive for data communications use. Despite its high cost, computer users have found it very effective to couple computers to communications lines to perform their work.

If data communications were less expensive, it would be used much more extensively. This has led the Federal Communications Commission to conclude that competition, rather than controlled monopoly, should be encouraged to drive down the cost and improve performance of data communications. The results so far have been encouraging. Data communications costs seem headed for a 50 percent reduction immediately and more later. Even at present rates, as many as 75 percent of the larger computer systems now being delivered are equipped to use some kind of data communication.

The expected availability of inexpensive means of data communications has led to the conception of entirely new kinds of computer systems in which information now stored in a large central computer may be distributed among a number of local computer centers interconnected by data communication links. Networks which operate in this way are already in use, for example, in the fields of law enforcement and credit validation. The national banking system is heading toward interconnection in such a system to handle the transfer, at electronic speeds, of money transactions throughout the nation and the world.

Revenue to communications carriers from this source now comprises only about 3 percent of the cost of operating computers and a roughly equal proportion of the income of communications carriers. The impact of data communications used in conjunction with computers is growing at a very rapid rate, however, and will at least triple in the next five years, growing about twice as fast as the market for computers.

These volumes of data transmission will be adequate to support specialized data communications services to most locations and we can expect to see the development of these services proceed at a rapid pace to match the needs of computer users.

Computer technology continues to improve the price-performance of computing equipment and his trend is expected to continue, but the most significant element in computer use is the people required to prepare programs, operate the equipment, and prepare input data. The cost of input data preparation has been under attack for some time and specialized devices designed to capture much of the input data without subsequent key stroking is beginning to become economical and go into widespread use. Other equipment is being made available which will help to cut down the work of computer operators. In the expensive activity of preparing computer programs, however, the key to improved effectiveness and efficiency is the development of improved "soft" aids for computer programers. In contrast to the aids to data input preparation and equipment operation, the solution to the cost of programing is primarily intellectual. The equipment to perform this work more efficiently already exists; it is the "software," or computer programs used to help the programer prepare other programs that must be improved. Indeed, the objective in programing aids is to eliminate the programer. There is no fundamental reason, even now, why the person who is able to describe the problem to be solved, and to postulate the procedure to be used in solving it, should have to learn a "foreign language" understood by the computer. The user should be able to describe the problem and procedure in language familiar to him and let the computer make the translation.

In relatively crude form, such aids presently exist, as "problem-oriented" languages used by programers to describe the problem to the computer. Ultimately, however, the programer will be able to communicate the problem to the computer, by speaking to it rather than putting instructions in writing.

Work in support of this objective is proceeding in a number of locations but no clear-cut answer is yet in hand. Judging by the rate at which advances in programing aids have been produced in the past, any practical solution to this problem, adopted on a wide-scale, is not likely before the mid-1980's, but the fact that it is feasible to consider such a solution serves to underscore the fact that computer technology and applications are only now beginning to be developed and that there is still a very long way to go before the ultimate usefulness of these devices is realized.

Exhibit 2.—*Speech of I. L. Auerbach Before Sixth Australian Computer Society Conference*

"The Information Revolution—Will It Improve the Quality of Life"

(By Isaac L. Auerbach, President, Auerbach Corp.)

Sixth Australian Computer Society Conference, Sydney, Australia, May 21, 1974

Mr. Chairman. Ladies and Gentlemen, Good evening. It is my distinct pleasure and honour to have been invited by Professor John Bennett to be here this evening to deliver this feature lecture and to participate in the sixth meeting of the Australian Computer Society.

Some years ago, a panel of judges was formed and asked to identify those people who they thought were most influential in shaping the world we live in. They deliberated for some time and concluded that there were four individuals

who they felt most influenced the shape of the world we live in. These were Charles Darwin, for his theory of evolution; Albert Einstein, for his theory of relativity, Sigmund Freud, for his work in psychoanalysis; and Karl Marx, for introducing communism. There is a very powerful message in the selection of these men: they were all creators of concepts, they were not conquerors, not rulers, not warriors, not inventors; from which I think we can determine that concepts are the most important matters that we deal with. Clearly ideas are the most potent influence that shape the future of civilisation.

It has been asked whether or not the electronic ditigal computer is such a concept or idea. I think that the computer is a very powerful influence, but history will have to assess its influence in shaping our world.

It has helped us create new languages, new social structures, new communication methods, and new ways in which we can live together. It is truly changing much of society as we know it. But as we evaluate the electronic computer today it has to be considered an invention, not an idea. And as an invention it will certainly rank with Marconi's telegraph, Alexander Graham Bell's telephone and the Wright brothers' airplane.

It is my intention here this evening to subdivide this lecture into three parts. First, to focus on the historical perspective of technology and try to understand some of these implications. Second, to illustrate by example the changes in our way of life that we may anticipate—or that we may have already experienced—that have been brought about as a result of computer technology. And third, to examine the sociological implications and the changes in the quality of life that information technology may cause.

Figure 1 is a graph of the world's population. The point of considerable interest is the shape of the curve, an exponential curve—one that I am going to ask you to observe in the next series of figures. Notice that by 1950 there were about two and one-half billion people on earth; now there are about three and a third billion people and by the year 2000, there will be six billion people.

Figure 2 shows the increase in the speed of travel through time from 1400 to 2000. Observe that until 1850, man moved on the face of the earth at about three to five miles per hour. By 1900 the automobile was available and man could move between 50 to 60 miles per hour. That's an order of magnitude, or a factor of 10, difference in the speed at which man moved over the surface of the earth. By the year 1950 man was moving between 500 to 600 miles per hour. It's of interest to observe that an order of magnitude quantitative change in technology can make a qualitative change in the life style we enjoy. Note that there were two orders of magnitude change in the speed of transportation by the year 1950, and in fact another is already technologically possible through the use of manned satellites.

In the field of communications, particularly telephones, see figure 3 which is another exponential curve showing the total number of telephones used in the United States alone, and will approach 176 million telephones by 1985. This is about one phone for every person over 10 years old.

Figure 4 is a bar chart showing the intervals between discovery and application in a physical science. The uppermost bar shows photography which took 112 years between discovery and application. The X-ray tube took 18 years, the transistor 5 years, solar battery 2 years. The interval continues to shrink, and the time compression between discovery and application is decreasing exponentially.

Now let me repeat my first thesis that an order of magnitude quantitative change in technology can yield a qualitative change in the quality of life. We can readily reflect on the changes in life style and the quality of life during the past 200 years as a result of the changes in transportation technology. We are currently experiencing changes in life as a result of the telephone, radio, and television. Changes may also be observed resulting from other technological advances.

According to the National Education Association, the exponential growth of man's knowledge is as shown in figure 5 plotted as a circle in which the area of the circle is proportional to the growth of man's knowledge. Man's knowledge at the time of Christ was not doubled until 1750. But the second doubling was completed 150 years later in 1900, and the fourth doubling of all man's knowledge took place in the decade of the 1950's. Figure 6 shows the same information plotted as a bar chart, and the conventional exponential curve is again recognizable. One may further observe that technology has multiplied by 10 every 50 years over the past 2,800 years.

The growth of the scientific manpower shown in figure 7 is linear over the past 150 years, which further accentuates the exponential changes scientists have wrought in advancing technology.

Let us now move closer to the main theme of this paper—information technology. Three disciplines are involved in information technology: computer technology, communications and information (see figure 8). The first, computer technology, consists of those devices relating to computer systems such as central processing units, memory devices, peripheral devices; and input/output systems such as keyboards, optical character readers and graphics.

The discipline of communications shown by the second circle is illustrated by teletype, telephone, radio, cable and satellite. The technological area common to these two disciplines—computer technology and communications—will prove to be one of the most fruitful that man has been involved with for quite some time. Communications and computer technology are growing so close together and are so mutually influential that it is going to be difficult to consider them as separate entities. This area includes such activities as time sharing systems, remote terminals and communicating computers.

Looking next at the third discipline, information, the basic technologies are human language, linguistics, logic and applied mathematics. The common area with the discipline of computer technology results in systems theory, metalanguage, machine language, system analysis and operations research. The activities in the area common to the three circles or disciplines result in the knowledge explosion and activities pertaining to governance, regulations, and standardization.

Having now more clearly defined the field of information technology and the critical role of the computer, it is pertinent to examine the rate of growth of this new technology. In figure 9 which plots the worldwide computer market for U.S. based manufacturers from 1955 to 1975, there are two groups of curves, the upper pair pertaining to general purpose computers, and the lower pair pertaining to minicomputers and dedicated application computer systems. The upper curves, one for cumulative number of computers installed reaching about 150 thousand units installed in 1975 and the other for cumulative dollars, are both exponential in shape. In recent years with the development of integrated circuits there has been a fantastic growth of a very small or minicomputer; the lower curves show the number of units of minicomputers rapidly approaching the 160,000 mark by 1975. But note the dotted line in the lower right-l .nd corner which is the dollar value of installed minicomputers. This anomaly is the driving economic force that is bringing about an even more rapid adoption of computers into hundreds of new fields.

Not only is the number of minicomputers continuing to increase exponentially, but with the cost decreasing exponentially there will be an intensification of the forces for change. Each new minicomputer is available at a fraction of the cost of those that were installed in the early days and this cost reduction will continue for some time particularly as minicomputers reach the market in large numbers.

Figure 10 shows cost of minicomputers decreasing exponentially going down to under $1,000 by 1980. In addition to these projections, microcomputers are forecasted to cost about $50 in less than 10 years.

Over the past twenty-five years, the main memory capacity available to large computers has gone up exponentially. Figure 11 shows the rate of increase of main memories to date. It is anticipated that it will increase by at least two orders of magnitude during the next ten years.

The reduction in computation cost for a computer with 10,000 operations per second capacity is shown in figure 12. This is a measure of the cost effectiveness of computers. These are the fundamental factors that lead me to the basic position regarding the direction in which the whole information revolution is moving.

With this introduction, we should now all be on the same wave length, as far as the growth of the industry, the increase in the capacity of minicomputers and their significant decrease in cost are concerned. Now let's proceed one step beyond and examine the hand-held calculator—*that* has experienced an explosive growth. In the year 1972, about half a million hand-held calculators were sold throughout the world. In the year 1973, over 10 million were sold; this year there will be at least a fifty percent increase in that number to something like 15 million hand-held cauculators. All of this has been made possible as a result of the ability to manufacture very complex electronic circuits on chips of silicon

or magnetic oxide material smaller than the size of the nail on your little finger. The cost of these chips is obviously extremely modest as reflected directly in the cost for calculators. The impact of the hand-held calculator has been rather dramatic due to very widespread acceptance as a result of its low cost and size. School teachers in the United States are pleading with parents not to let their children borrow the hand-held calculator to do their homework because they find the children are not learning arithmetic, particularly multilpication and division. There are those who ask whether it is necessary to memorize the multiplication tables? Why do so when a device so easily portable is available to do multiplication and division, at a cost of $25 or less. Is it necessary to even be bothered learning arithmetic? These are some of the questions that are beginning to challenge educators as the tremendous impact of this one aspect of computer technology is felt around the world.

Let us return to the mainstream of this lecture and the impact of mini- and microcomputer technology on society. In November 1973, minicomputers were being produced at the rate of 2800 per month. It is forecast that within five years they will be produced at a rate of in excess of 10,000 per month. These minicomputers are going to be significantly different from the general purpose computers referred to earlier. They are going to be predominantly specialized application devices whose function will be dedicated to one purpose. The microcomputer with 4,000 words of memory is selling today for under $900 and by the end of this decade, will be manufactured for less than $50.

One must fully understand the power and utility of these microcomputers, and their very low cost to appreciate the future. When it is recognized that these microcomputers equipped with a cathode-ray screen and keyboard will cost about the same as a television set or less, then the kinds of applications possible come into sharper focus. This is no longer a change in degree, but a radical change in the kinds of applications for computers in the future. Here I would like to develop some verbal pictures of some of these applications that either have already been proven or that will be developed with such rapidity that three years from now, they will be history. Certainly before the end of this decade many of these applications will be taken for granted.

People have talked for a long time about using minicomputers in their own homes. What can you do with one, is the question. Well let's start by evaluating its use in the field of education. Ten years ago a device called a teaching machine was introduced to the market. Professor B. F. Skinner of Harvard fathered some of these ideas. There was a plethora of such devices, some very crude and frequently unsuccessfully programmed, that were supposed to enable us to learn more rapidly and more easily. The process was not fully understood and the programs were poor—the product failed. However, with a microcomputer that can control the teaching process and by perfecting the programs which may be inserted on simple tape cassettes, this can be an accepted method of teaching. For everyday reference for the student and all in the household, add to that the availability of an updatable electronic encyclopedia that can do searching for appropriate material on a subject.

Minicalculators, not just hand-held but rather complex ones, are going to be available to assist in such things as tax returns, shopping lists, keeping track of things to do, investments, receipts, and diets. The whole field of word processing, now just embryonic, is going to become an accepted technique. It should be possible to plug a special electric typewriter into the microcomputer and perform functions only sophisticated office equipment can do now.

What about the field of entertainment? The minicomputer and the microcomputer in your TV set will enable you to play games such as ping pong, bridge, chess, etc. Personalized data banks and reference services will be available to ascertain weather, news, stock quotations, and not the least, keep track of the value of your portfolio. These are some of the things that can happen within the next eight years by having a microcomputer terminal at home.

Let us turn to the field of transportation and examine the possible impact of the minicomputer or microcomputer. Dr. Charles T. Helvey of the University of Tennessee has created a very interesting scenario. He states that the goal of traffic control is to move automobiles at the maximum speed, at maximum safety at minimum cost. With that as the goal it is proposed that each individual will have his automobile pretested annually to determine its performance characteristics with an optimum driver. The automobile will then be rated. Each person will also be tested to determine skill and response times. These facts will be stored about the driver in a plastic card—about the car in the memory of

its microcomputer. As the car is driven, the microcomputer will be fed data from sensors on the road bed, the steering wheel, gas and brake pedal, to track the performance of the car, the driver and road conditions.

Before the car can be started, the card must be inserted into a slot in the car which will then read the data from the card into the microcomputer; and if this is not done, it will not start. Depending upon the state of fatigue or inebriation of the driver and his response time in controlling the car, the performance of the system (the car, the driver and road conditions) will be matched against the limits present within the minicomputer. If the computer indicates abnormal performance for the driving speed, a flashing light will go on in the car which will also be visible to other automobiles so that the drivers can take defensive measures. The police can also note the flashing light if the speed of the car and its control are not brought into balance. You can rest assured that a traffic ticket will be issued and restrictions imposed.

I wonder how many of us are aware of the role that fractional horsepower motors play in our lives. This invention is over 25 years old. Did you know that in some of the more modern-equipped automobiles there are over 25 fractional horsepower motors? That you can now brush your teeth with a fractional horsepower motor, or shave, or beat eggs, or open cans or your garage door? The list can go on for thousands of such things. The house is literally filled with fractional horsepower motors, and yet none of us gives the first thought to the fact that 20 years ago they hardly were used or that we are, in fact, using a motor; we just take them for granted. This happened because of the great decrease in the manufacturing cost of fractional horsepower motors. I predict that within 20 years the microcomputer will similarly involve itself in our lives, in almost anything and everything we do to an extent that is beyond my imagination to forecast.

Let us look at other examples that should be of particular interest here in Australia where the subject of health care is so vital and such an important part of your government's activities. A newspaper reported on a fascinating experiment conducted at Harvard and M.I.T. on a protocol system for diagnosis. Although the methodology need not use a computer, it was the computer that triggered the development and, in fact, can easily be used to monitor and extend the technique. The doctors have developed a step-by-step logical approach to learning about a particular medical ailment which, if systematically followed, can lead to a correct diagnosis. A simple questionnaire has been developed and tested using nurses, military medics and even minimally trained paramedicals to diagnose and prescribe for certain common medical problems with accuracy, safety and patient satisfaction. It is used primarily for complaints such as coughs, sore throats, vaginal infections and back pains, and such chronic conditions as diabetes, hypertension, and follow-up treatments in pregnancy. The form, rarely more than a single printed page, asks for specific symptoms and medical history to be noted, then specific physical examinations are made based on the checklists and lab tests recommended. The form is a simple, easy to follow chart with yes-no answers. The response of one question, in fact, dictates the next question. This logically structured data collection technique and eventual diagnosis is completely individualized. A printed card orders the type of action for each patient, initiates tests, or prescribes specific medication or treatment or a referral to a doctor.

Doctors have been routinely checking the protocol with the patients before they leave to make sure that all the steps have been followed with no unusual danger signals being ignored. The time-saving is tremendous. The Harvard/M.I.T. team reports that 75% of the patients examined by protocol by nurses for respiratory symptoms were treated and sent home without ever being seen by a doctor; likewise, with over 80% of the women with vaginal complaints. Most any intelligent, thorough, warm person, even one without prior health experience, seems able to administer the protocol, and the diagnosis seems to be extremely accurate and the prescriptions highly effective.

In the field of electrocardiography much progress has been made. The electrocardiograph measurements may be fed into a computer and the wave patterns can be interpreted and diagnoses indicated quite frankly better than by the average doctor. Of potentially greater interest is the ability to identify cardiac-prone patients. Many of us know people who, having just left the doctor's office where an electrocardiogram was taken, die within a few days of heart failure. Why could the doctor not identify these symptoms? It may now be possible using a computer. By programming the computer to be over-selective it can find deviations in cardiograms which may not normally be detected by the naked eye.

Research studies have shown that a computer can identify those who have a high predisposition to future coronary and arterial diseases.

In the field of tumor treatment much has already been achieved. The Washington University hospital in St. Louis has been using a computer to prescribe radiation treatment for at least six years. The goal is to maximize the dosage in the organ that is afflicted and minimize the damaging exposure to the skin and other muscles around the area by a series of multiple exposures at different angles to the body, radiation area, exposure time, and radioactive strength rather than a broader single exposure as was done in the past.

In the field of intensive care it is possible to connect a patient to a computer monitor that would be more effective than dependence on observation by available nursing staff. The condition of the patient in the intensive care unit is followed by constant electronic monitoring of multiple physiological parameters such as pulse, blood pressure, heart rate, body temperature, respiration rate, and oxygen rate. In an uncomputerized intensive care unit, the evaluation and the importance of changes of these various measurements, individually, and as related to each other, may often take time; time that is crucial in the care of the patient. In computer-monitored intensive care unit, the very subtle equilibrium beween these various factors is expressed mathematically as input into the computer, and the slightest deviation is often detected before a critical symptom is even visible.

The administrative services of a hospital entail a large amount of scheduling and clerical work. One must allocate the resources of rooms available for special types of treatment, deal with the complexity of locating patients who may be moved from room to room in the hospital, provide for the sequence of the patient's treatment, time of admission, time of discharge, and countless other details. A record of patient movement throughout the hospital is easily stored in a computer and determination for various treatments, medication, and other records enables significant improvement in the administration of the complex, modern hospital. A daily census, carried out at midnight when mobility is at a minimum, gives the location and status of each bed and each patient in the hospital. All clinical investigations and laboratory results for a particular day or period may then be entered into a patient's record for examination by the doctor first thing in the morning. This is accomplished by locating minicomputer-controlled remote printers at each major nursing station, avoiding the uncertainties of mail delivery. The complete computer storage of the patient's total medical history is important in prescribing treatment and is readily accessible through computerized files.

Let us probe into a totally different area—that of distribution. Last week, in the United States, a major step was taken to expedite the automation of food check-out in supermarkets. Manufacturers, wholesalers and retailers of food products have finally agreed on a universal product code. Each product will be identified by a ten-bar code. Five of the bars identify the manufacturer and five identify the product. By the end of this year, more than half of all the manufacturers of food products in the United States will have this ten-bar code inscribed on the food packages. It will no longer be necessary to stamp the price on a product to be read by the checkout clerk. The price will be posted in the front of the shelf from which you select the product. As the bar code is exposed to an electronic reader or an electronic wand, the computer will look up in its memory the current price for that product. A printout will be prepared that will list the product name, the price and the total. This will enable the shopper to vertify what was purchased and, if desired, do comparison shopping on a week-to-week basis. It is claimed that this will yield 60 to 70 percent speedup in checkout process and eliminate the hand stamping of each product with its price. Not only will this method achieve a long-sought-after goal, but also inventory control and reordering can now be automatic because the sales data can be captured within the computer. Sales analysis, location analysis, and many other mangement reports can be easily prepared. Likewise, the whole process of warehousing and shipping can be automated and help reduce the very high cost of food distribution.

I believe the information revolution will have a greater impact on the ordinary citizen and the environment within which we live than atomic energy or, in fact, any other technological development for the rest of this century. Almost everyone will be affected more or less dramatically by computers, including the use of their leisure time.

The number of computer installations that exist today represents only two to three percent of the total computing power that will be in place 10 years from now. So, to those of you who are concerned about not being able to understand

some of the current computers, don't worry about them. Just start thinking about the ones that will be around five and ten years from now. The only limiting factor to this projection is cost, and all the indicators as shown by the previous graphs clearly demonstrate that the cost factor is headed in the right direction—down.

The third part of this presentatio on the consequences of the application of new technology on the quality of life will now be developed.

My friend, Dr. Eugene Fubini, has proposed a law in four phases that defines the consequences of the application of new technology on the quality of life. His first phase states that when a new technology is developed, the first thing people do is to use the new technology to do what they did before but only do it better. (see figure 13). For example, the internal combustion engine was first used to take the place of horses, and created the horseless carriage; likewise, television initially took the place of a teacher in a classroom.

In the second phase, man thinks of new things that have not been done before. Re-examining the internal combustion engine one observes that buses and trucks were created and also plows and other agricultural machinery to take the place of agricultural workers. In the case of television, movies were adapted to the media, and of greater significance TV brought live news into our homes every day. TV certainly has changed the whole pattern and style of political campaigns.

The third phase provides that our life style be changed to match the technology. The internal combustion engine made possible supermarkets, major shopping centers, and suburbs. With television children now stay home and watch television rathe than go out and play. What is essentially created for them is a vicarious type of experience through television which the school was supposed to supply to the pre-TV-aged child.

These effects laid the foundation for structural changes in our lives. For example, the internal combustion engine not only enabled the creation of suburbs and supermarkets, but also started a population shift of poor people moving from the country into the cities as they were displaced by agricultural machinery, filling the spaces in the cities vacated by the exodus of the wealthy who were moving into the suburbs. Therefore, in a way it may be observed that the internal combustion engine was the cause of the ghettos.

Which leads to the fourth phase—out of these social consequences a new culture is formed. It is predictable that the video telephone will eventually significantly reduce travel by automobile and airplane. This development will occur as we gain the ability to say over the phone "show it to me," which will lead to more visits by communications media than by physical transportation.

Let use examine the consequences of the application of computer technology as it progresses through the four phases of Fubini's Law. Refer again to figure 13. Initially, the computer did what was done before—only faster. It replaced large numbers of people who solved problems on calculators. And it wasn't too long before we could do things that had not been practical or possible and computers were applied, for example, to planning all facts of construction and road building, in complex control systems, to machine tool controls, guided missiles and space flights. And now with the low cost minicomputer and microcomputer, we foresee a change in our life style. For example, the credit card economy is the first step in the creation of a totally new life style in which money need no longer be carried. In the banking industry, this is a very serious matter, because banks, along with all other financial institutions, are deeply concerned with their future role in society. I am sure that your banks, like those in the United States and in Japan, are examining all methods of electronic fund transfer and are researching ways in which banks can be involved in the cashless society. Without a doubt, we will change our life style to accept the new applications of computer technology. Quite frankly, no one can foresee the social consequences that will derive from this formidable dynamic force.

Let me bring the work of another friend and expert to bear on the subject. Dr. C. C. Gotlieb of the University of Toronto has written a book with Dr. Allan Borodin and they have made some very interesting observations on the spectrum of problem areas with regard to computers. See figure 14. There is a progresssion or scale from the technical pedagogical and management problems at one end of the spectrum of problen ireas, to social, ethical and philosophical problems at the other. The spectrum changes from well-structured, unambiguous formulated problems at one end to those that are more loosely defined and poorly understood at the other. If there are completely defined abstractions of physical systems or if the actual system can be studied and modified, it is possible to pose some interesting technical questions with the hope of getting reasonably precise

responses. If mathematical reasoning or experimental techniques can be applied to answer questions, or if solutions may have measurable accuracy, we are closer to the left end. As we move to the right from the physical and mathematical sciences into the social sciences of economics, sociology and political economy, the responses become less precise and more philosophical. Here the problems might better be described as issues and the advantages and disadvantages of various courses of actions debated. Solutions, or better, the resolutions, depend on agreement among values, goals and techniques. At the end of the spectrum are ethical and philosophical questions which we cannot answer but we can only hope to illuminate the issues by examining semantics of the terms involved.

I have presented a brief overview of where information technology stands in the spectrum of problem areas. They are predominantly on the left side and middle of figure 13. The technical, managerial and economic problem areas are well in hand; however, the legal and political areas are not even adequately defined, while the ethical, social and philosophical areas have hardly been addressed.

In its short span of 25 years, the computer has pervaded to a greater or lesser degree every activity of business, government, education and industry, but without exception has affected them all appreciably, and the potential applications have hardly been tapped. Other history-making advances in technology may be dwarfed in importance by the influence of the computer on our lives and our environment. There is no doubt that the information revolution will affect the quality of life. It remains to be seen whether the information revolution will *improve* the quality of life and we must all share the responsibility for this consequence.

You have been a most attentive audience and thank you for inviting me.

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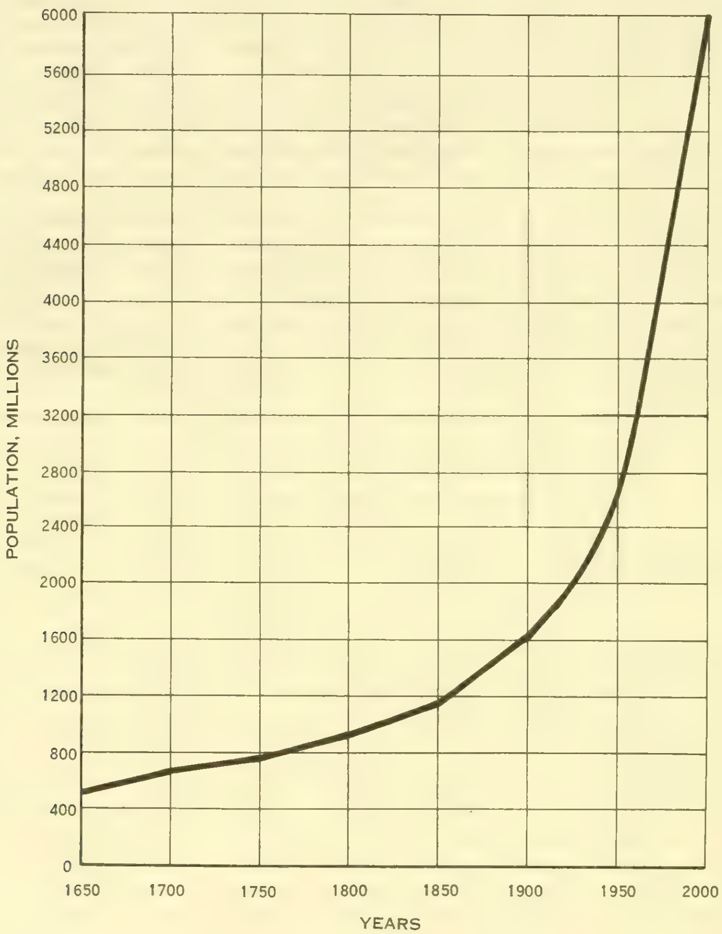
WORLD POPULATION
1650—2000



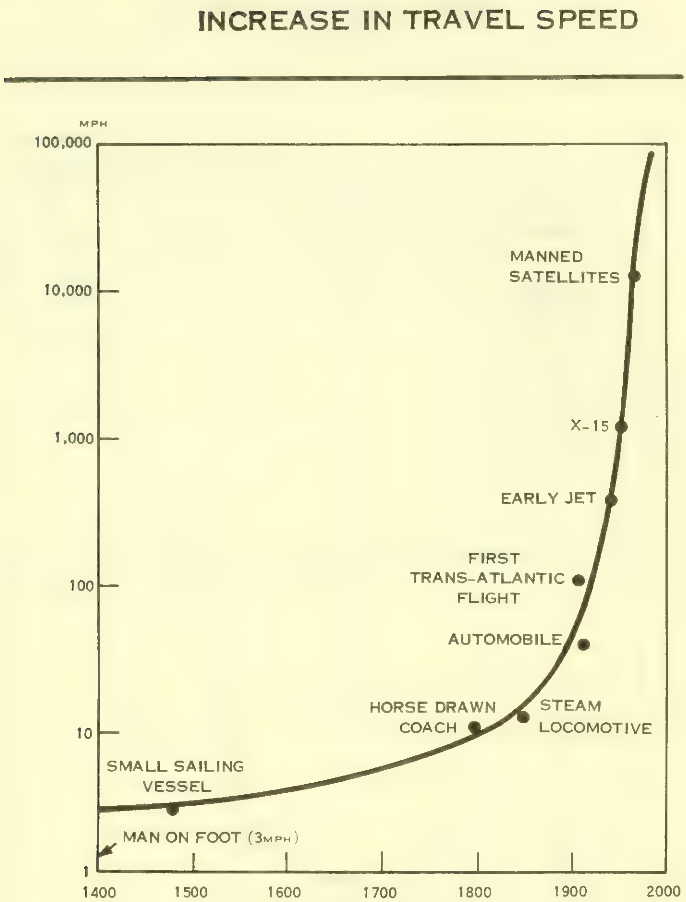

INCREASE IN TRAVEL SPEED
MPH
100,000
10,000
1,000
100
10
1
1400
1500
1600
1700
1800
1900
2000
MANNED
SATELLITES
X-15
EARLY JET
FIRST
TRANS-ATLANTIC
FLIGHT
AUTOMOBILE
HORSE DRAWN
COACH
STEAM
LOCOMOTIVE
SMALL SAILING
VESSEL
MAN ON FOOT (3MPH)

Fig. 2

TELEPHONE COMMUNICATIONS
1880—1985

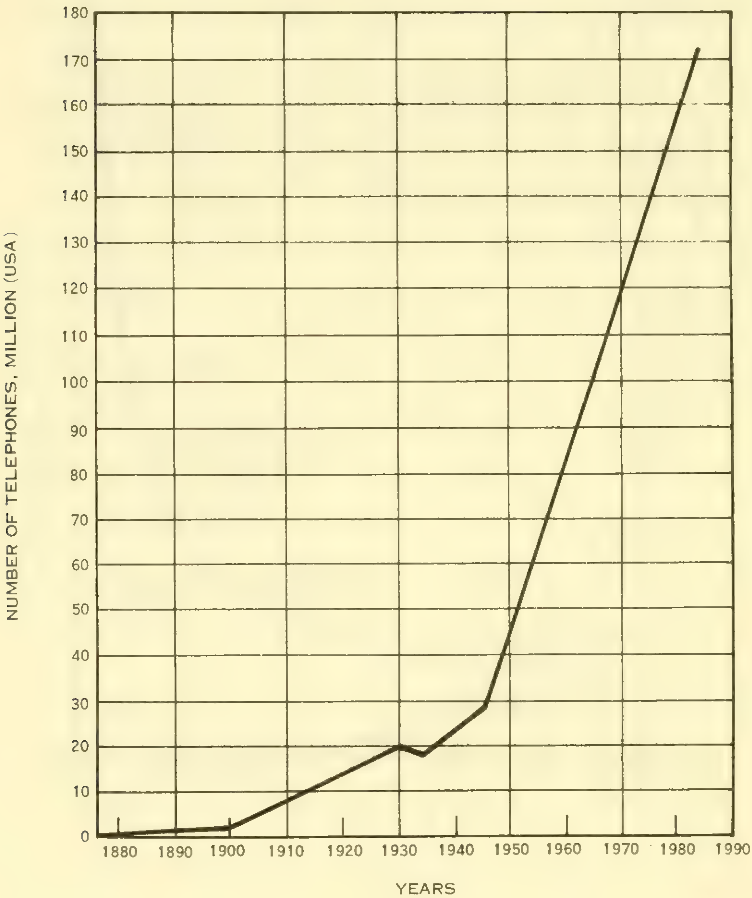


Fig. 3

THE SPEED OF CHANGE

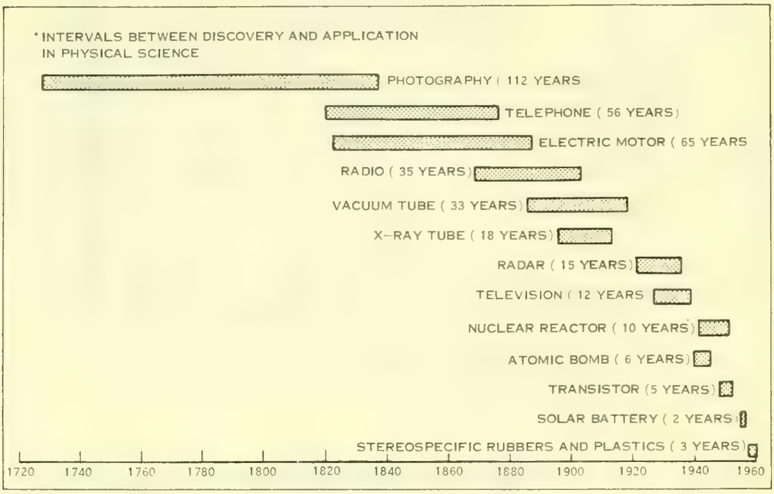
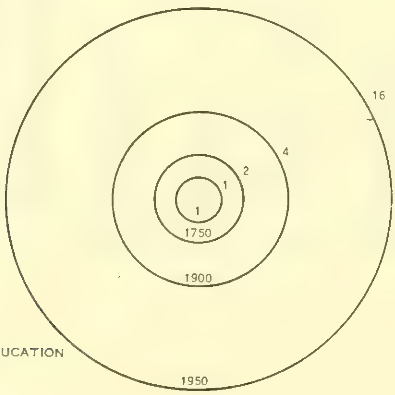


Fig. 4

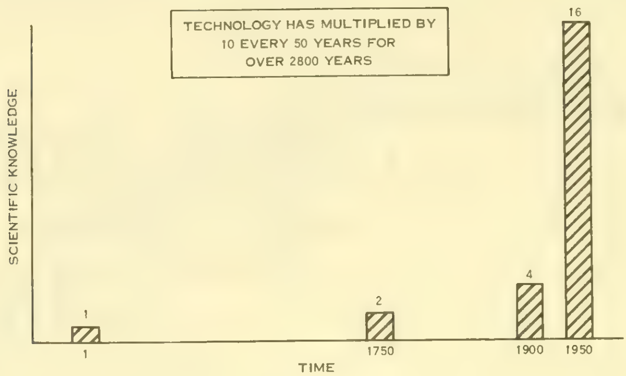
EXPONENTIAL GROWTH OF SCIENTIFIC KNOWLEDGE



SOURCE: NATIONAL EDUCATION ASSN., USA

Fig. 5

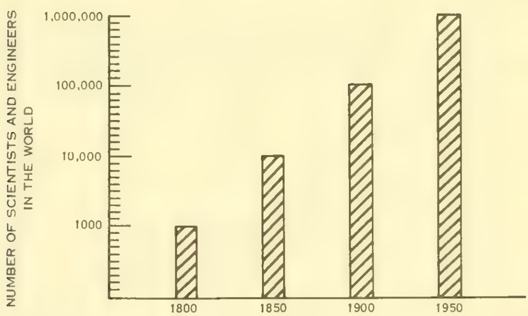
EXPONENTIAL GROWTH OF SCIENTIFIC KNOWLEDGE



SOURCE: NATIONAL EDUCATION ASSN., USA

Fig. 6

EXPONENTIAL GROWTH OF SCIENTIFIC MANPOWER



SOURCE: NATIONAL EDUCATION ASSN., USA

Fig. 7

WHAT IS INFORMATION TECHNOLOGY ?

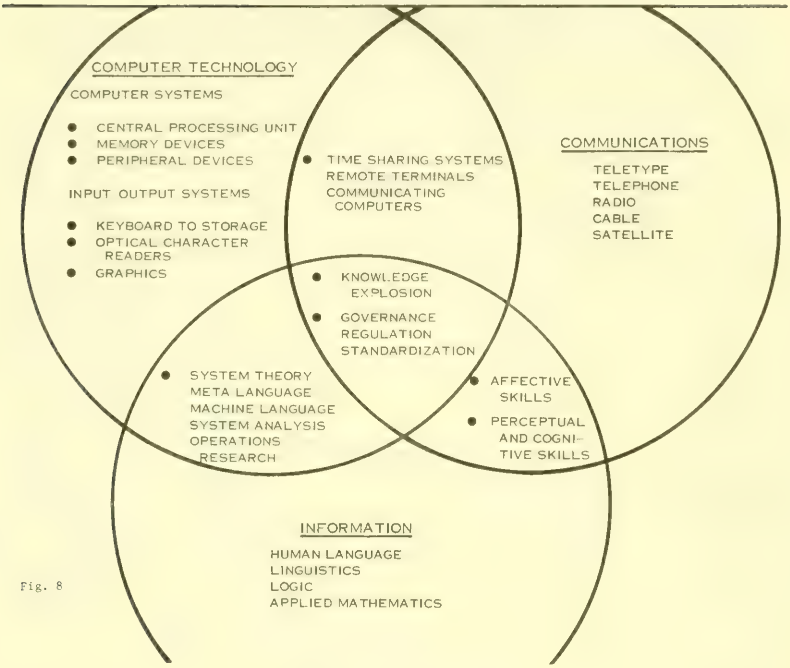


Fig. 8

WORLDWIDE COMPUTER MARKET
(U.S. BASED MANUFACTURERS)
FOR 1955 TO 1975

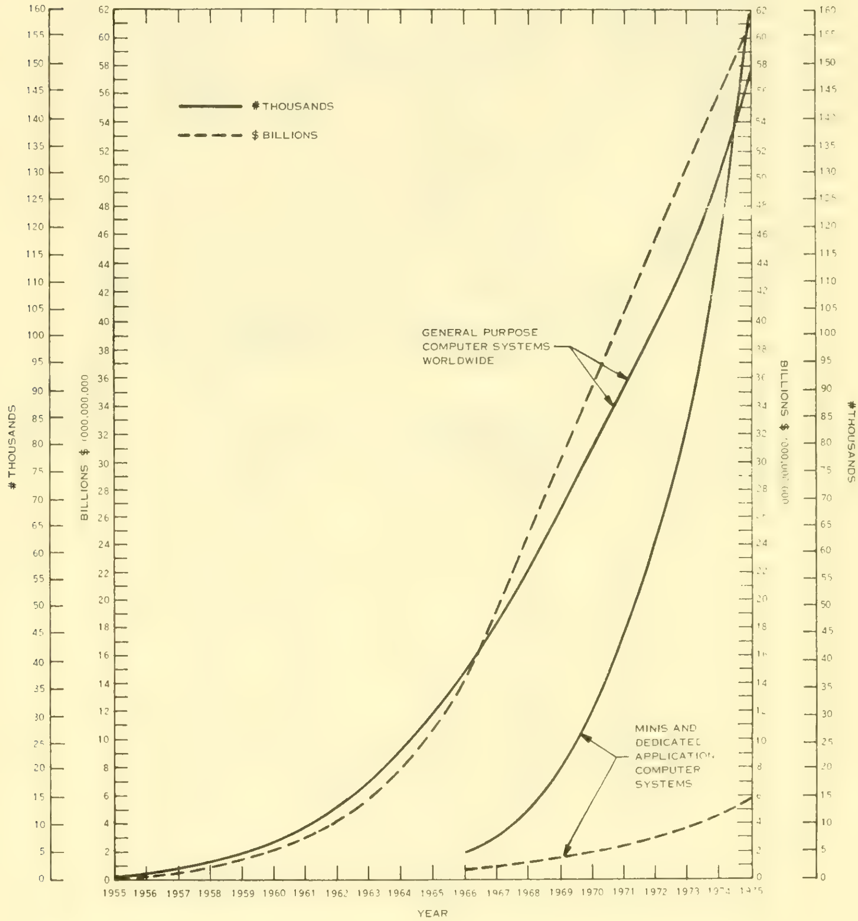


Fig. 9

TREND IN MINI COMPUTER CPU PRICES

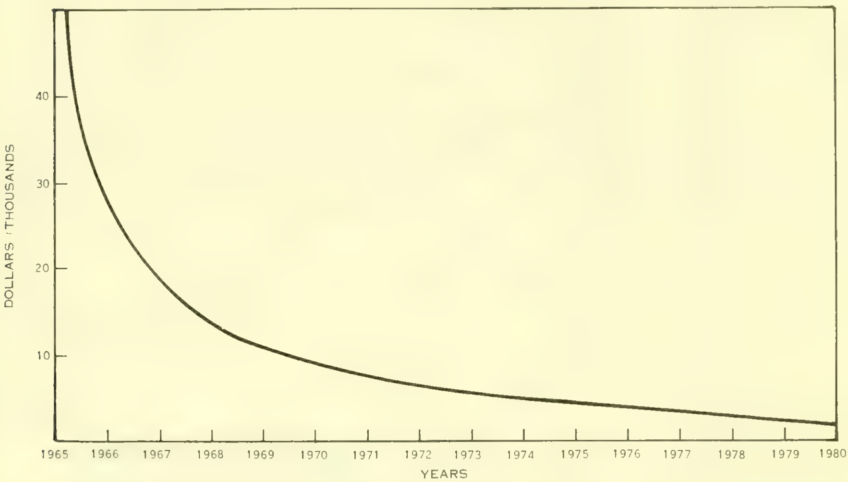


Fig. 10

MAXIMUM MAIN MEMORY CAPACITY AVAILABLE IN LARGE COMPUTER SYSTEMS

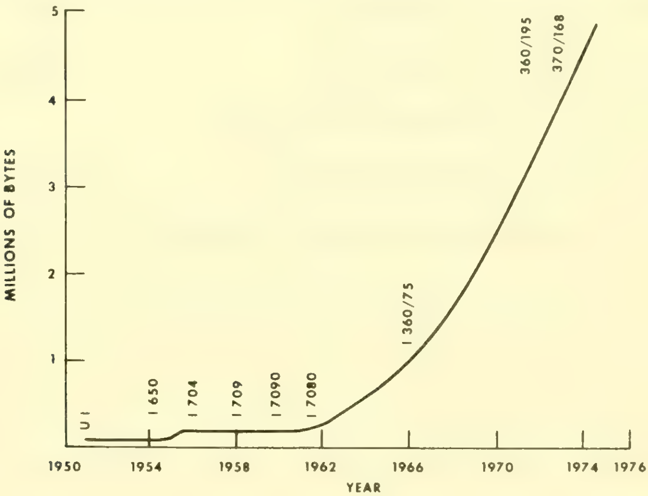
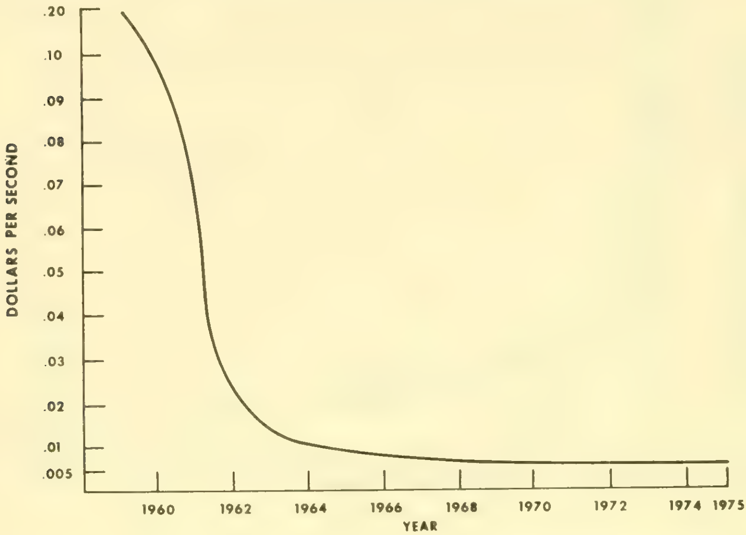


Fig. 11

REDUCTION IN COMPUTATION COST FOR A COMPUTER WITH 10,000 OPERATIONS/SECOND CAPABILITY



SOURCE: AUERBACH COMPUTER TECHNOLOGY REPORTS

Fig. 12

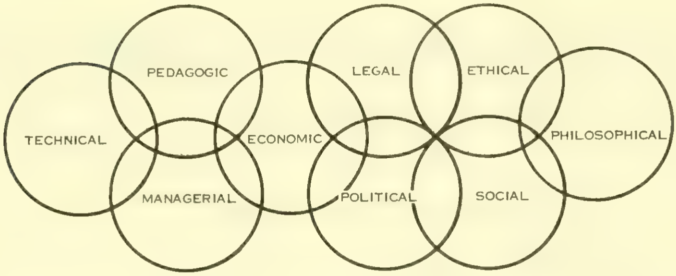
CONSEQUENCES OF THE APPLICATION OF NEW TECHNOLOGY

FUBINI'S LAW

1. DO WHAT IS BEING DONE — ONLY BETTER.
2. DO WHAT WAS NOT DONE BEFORE.
3. CHANGE LIFE STYLE TO MATCH TECHNOLOGY.
4. SOCIAL CONSEQUENCES FORM A NEW CULTURE.

Fig. 13

SPECTRUM OF PROBLEM AREAS WITH REGARD TO COMPUTERS



SOCIAL ISSUES IN COMPUTING, GOTLIEB AND BORODIN

Fig. 14

THE INDUSTRIAL REORGANIZATION ACT (S. 1167)

(The Computer Industry)

WEDNESDAY, JULY 24, 1974

U.S. Senate,
Subcommittee on Antitrust and Monopoly
of the Committee on the Judiciary,
Washington, D.C.

The subcommittee met at 10 a.m. in room 2228, Dirksen Senate Office Building, Hon. Philip A. Hart (Chairman of the subcommittee) presiding.

Present: Senators Hart and Hruska.

Staff present: Howard E. O'Leary, Jr., chief counsel; Bernard Nash, assistant counsel; Janice Williams, chief clerk; Peter N. Chumbris, minority chief counsel; Charles E. Kern, II, minority counsel; and Michael Granfield, minority economist.

Senator Hart. The subcommittee will be in order.

The first witness this morning is someone who has testified in earlier days before the subcommittee, Mr. Jack Biddle, the executive director of the Computer Industry Association. We welcome you back.

STATEMENT OF A. G. W. BIDDLE, EXECUTIVE DIRECTOR, COMPUTER INDUSTRY ASSOCIATION, ENCINO, CALIF.

Mr. Biddle. Gentlemen, we appreciate this opportunity to appear before this committee to present our testimony on what we believe to be an issue of critical importance to both our industry and our Nation.

Although my statement is rather long, I will endeavor to summarize it, Senator.

Senator Hart. We'll have it printed in full.

[Mr. Biddle's prepared statement appears at the end of his oral testimony as exhibit 1.]

Mr. Biddle. The Computer Industry Association represents 40 member companies with combined annual revenues in excess of $1.5 billion and employing more than 40,000 people.

Our individual member firms range in size from under $1 million in annual sales to something in excess of $200 million. We have attached a list of our member firms to our testimony.

Their products cover the full spectrum of goods and services associated with computers and data processing: main frames, memories, tape drives, disk drives, printers, data entry devices, terminals, software, and services such as leasing and systems consulting.

The association was formed 2 years ago this month. Its objective then and now is to endeavor to bring about free and open competition within the computer and data processing industry; an industry that has, since its inception, been dominated and controlled by one company—IBM.

In many respects our association was born of frustration. Its founders had come to realize that no matter how superior their technology, or how good their product, sales, or service, their existence as viable companies would remain at the sufferance of the industry giant.

Our founders frustrations ran even deeper. One Federal antimonopoly suit against the giant resulted in a consent decree that did little to reduce the defendant's market share or power.

Another suit was filed on the last day of the Johnson administration and for more than 3 years nothing had happened to bring it to trial.

We feel that the time has come for some decisions. If we, as a nation, believe in the concept of competition and in the benefits of a free enterprise system, then we must take steps to make that system work.

The legislative mandate must be clarified and the enforcement machinery modernized and streamlined. The entrepreneur must be able, once again, to succeed or to fail on his own merits.

He should not be kept in business through governmental intervention if his activity is not providing economic benefit nor should he be put out of business by a monopolist when his existence benefits the consumer and the Nation.

We believe that free and open competition between near equals is good for producers, consumers, and the economic health of our Nation.

That others share this belief is borne out in part by the fact that our membership has increased by a factor of five since we appeared before this committee 1 year ago.

Since that time a lot has happened. Our association has asked the Office of Management and Budget to double the allocation for the Justice Department's Antitrust Division.

We have endorsed in testimony the Tunney bill, which requires public access to the consent decree process. We've asked the Department of Justice to seek interim relief pending the outcome of the *U.S.* v. *IBM* case.

We asked the Federal court in Tulsa, Okla., to insure that IBM documents introduced into the public record as evidence would not be destroyed.

We are actively pushing for standards, both domestically and internationally, to promote the interchangeability of computer equipment and to increase competition in the computer industry.

We recently offered $50,000 as seed money to form an independent computer users association so that the user could be represented at hearings such as this.

We have asked the Congress to amend the Public Utilities Holding Company Act to include telephone holding companies; and we have endeavored to stimulate informed public discussion of the problems of concentration in our industry and of possible solutions that would serve the best interests of the three constituencies: users, competitors, and investors.

In this regard, Senator, we did hold a background briefing for the Washington press corps day before yesterday seeking to encourage their attendance at these hearings.

I would like, if I may, to enter the materials distributed at that conference into the record at this time.

Senator HART. They will be received.

[The materials referred to appear as attachments to exhibit 1.]

Mr. BIDDLE. Some of the items include a reprint of a recent article in Harper's magazine, along with the ensuing letters to the editor; statistical data on the industry; a glossary of terms so that the layman can understand some of the terminology that we frequently use in this industry; advances for release on the statements of myself and Dan L. McGurk, and reprints of articles from More magazine; Electronics magazine and Business Week.

In addition, during the past year, IBM was found guilty of monopolization and attempt to monopolize by a Federal district court in a private antitrust case and preparations for the trial of *U.S.* v. *IBM* have accelerated with the trial due to begin this October.

In the meantime IBM has become more, not less, aggressive. Their unilateral control of the marketplace remains intact and the prospects for near-term relief for our industry continue to be dim.

For this reason our association came to this committee and asked for an opportunity to testify. Relief for our industry through the application of the antitrust laws is still many years away.

The fact that this committee is holding hearings on this critical industry is encouraging, as is the fact that the House and Senate have acted favorably on the Antitrust Division's budget request.

However, for the problem before us to be solved it must first be understood. In the hope that we can contribute to the deliberations of this committee we would like to make the following key points.

One, the computer, as we heard in yesterday's testimony, has quietly revolutionized life in America. In doing so it has become the central nervous system of our entire economy.

Two, the computer industry is dominated and controlled almost in its entirety by one company, IBM. The extent of their monopoly control is second only to that of A.T. & T.'s over the telephone industry.

Three, the maintenance of their monopoly control is based upon a number of interlocking strategies, some subtle, some markedly predatory.

Four, IBM's continued control over the computer industry enables it to control the central nervous system of our Nation's economy, representing what we believe to be, as citizens, a real and dangerous threat to the United States.

Five, the elimination of monopoly power and control of this industry requires an understanding and appreciation of the subtle strategies and techniques used to maintain it.

Six, our present antitrust laws and enforcement procedures appear unable to effectively deal with the problem.

The first commercially built computer, the Univac I, was delivered to the Bureau of the Census in 1951. In little more than two decades the computer has, in fact, had major and far-reaching impact on our Nation and our way of life.

To a large extent the computer has made advances in other technologies possible. It has taken over the boring and repetitive tasks and freed man's hands and mind for more creative work.

As each day goes by new applications are found for these wondrous machines. New tasks are performed with lightning speed and accuracy.

In many respects this revolution has occurred quietly. Few of us ever see a computer. We're almost totally unaware of the literally thousands of computers installed and operating in our country today.

As Mr. Parkin of CDC told us yesterday, computers sort our mail, schedule our airlines, process our checks, control our electric power, print out our paychecks, and calculate our bills.

Wall Street, the Federal Government, the defense establishment, our transportation system, our banking system, our utilities and our manufacturers, are all totally dependent upon the continued operation of their data processing equipment.

It has taken us two decades to convert from clerks and reams of paper to the high-speed processing of millions of pieces of information contained in a single magnetic tape or disk.

The task of reversing this process, should it ever become necessary, would be virtually impossible. There is no going back.

Today the smooth functioning of our Nation's economy is synonymous with, and wholly dependent upon, the smooth functioning of our installed base of electronic computers.

Unfortunately, a situation has developed that threatens the operation of this key national resource. In the computer field, the lack of standards has made the interchange of equipment and media between systems difficult and inefficient.

Few people not intimately involved with our industry are cognizant of the fact that each computer center is unique unto itself. There is simply no way to borrow the computer next door.

This is equally true of an auto manufacturer's assemblyline, an airline's reservation system, or Federal Reserve banks clearing operations.

In each instance they must rely upon their computer system supplier for systems service and support. There is no other alternative.

The significance of what I've described above becomes clear when one realizes that 7 out of 10 computers in America today were produced and are serviced by one entity, IBM.

If, for the sake of illustration, their field service organization were unavailable for 2 weeks, our Nation would slowly and inexorably grind to a halt.

The transportation system, the banking system, the communications system, and the Fortune 500 manufacturing companies would all cease functioning—layoffs would be in the millions—creating chaos beyond comprehension.

Personally, I know of no other single corporation in the world with this much potential power over a nation's economy. Although they surely wouldn't abuse it, the very possession of this much power in the hands of a few people is frightening.

It is all the more so when one realizes that few Americans, including their Representatives on Capitol Hill, even know that it exists.

It is, I believe, important for the committee to understand how this situation came about. The computer industry can be a classic case study through which some important lessons might be learned about the monopolization of high technology industries and some insights gained as to the effectiveness of existing antitrust laws in our present environment.

Tomorrow my colleague, Dan L. McGurk, will comment on some actions that this committee and the Congress might take to rectify this situation.

Although most people associate the beginnings of the computer industry with the first commercial Univac I, the data processing industry as we know it is an extension of the punched-card tabulating machine industry, an industry that goes back to the 1930's.

Judge Earl R. Larson, in deciding the *Honeywell, Inc.* v. *Sperry Rand* case—civil action 4–67 CIV 138, U.S. District Court, 4th District, Minnesota—recognized the transfer of market control that took place during the transition from punched-card equipment to digital computers.

In his findings of fact and conclusions of law, Judge Larson said:

> In 1956, IBM was the principal U.S. supplier of 80 column tab card equipment. The tremendous customer base which IBM had because of its domination of the tabulating industry had a good deal to do with its position in the early days of EDP industry, and * * * gave them the predominant role, which has tended to perpetuate itself.

Further, he went on to note that in 1956, IBM shipped 85 percent of all new equipment. "At the end of 1956, IBM had 75 percent of all EDP systems outstanding" in America.

Against this background it is important to note the Department of Justice filed an antitrust suit against IBM on January 21, 1952.

The Government suit charged IBM with monopolizing the tabulating machine industry and engaging in various restrictive practices in the conduct of business.

At the time the Government action was filed, and for some years thereafter, IBM had about a 90-percent share of the tabulating equipment business.

On January 25, 1956, the U.S. District Court for the Southern District of New York, Judge Edelstein presiding, approved a consent decree entered in the case of the *United States* v. *IBM*.

The decree contained numerous remedial provisions directed at the IBM tab monopoly and to a limited extent at its rapidly growing EDP monopoly.

In retrospect, it is clear the Department of Justice failed to realize that IBM's monopoly of the tab market had already served its purpose. It provided them with a massive customer base which could be converted over to computers and in turn, allow them to escape from the more onorous provisions of the consent decree.

IBM's monopoly control was not shaken. During the period 1955 through 1967, IBM's share of the general purpose data processing market fluctuated between 65 and 78 percent.

During this period, it should also be noted that some very able and well-financed companies took an active interest in the computer industry.

My first assignment when I joined the professional staff of Booz, Allen & Hamilton in 1957 as a consultant was to examine the computer market for the Bendix Corp.

At that time the EDP market appeared to be highly competitive and a number of companies were seeking to establish themselves.

The *United States* v. *IBM* consent decree had been signed and heralded as a significant step toward establishing competition in the computer marketplace.

Meaningful competition, however, did not develop. No competitor, other than Sperry Rand, attained more than a 5-percent share of the installed computer base through the year 1967.

In late 1960, I was again asked to examine the computer market for Bendix.

They had been a competitor for some 4 years and achieved annual sales of over $10 million. They had a good computer already in the marketplace and several others in development.

Yet when all of the facts were in we were forced to conclude that they had no alternative but to withdraw from the computer industry.

Our reasoning in 1960 remains valid today. First, IBM and its nearest competitor can be expected to continue to hold more than 70 percent of the market.

Next, IBM has established a pattern of rental that requires the infusion of massive amounts of capital and substantial losses before break-even.

Three, IBM sets de facto standards for the industry, unilaterally and secretly.

Four, participation in the computer market requires major expenditures for hardware and software development in the creation of a large nationwide sales and service organization, even before you begin.

In our report to the Bendix board we concluded:

> * * * in addition to IBM, in light of their control of 70 percent of the market, there is room in the computer industry for only two or three other companies on a profitable basis.
>
> Currently there are at least 16 companies [1960], almost all of which are knowledgeable, well-financed firms with an avowed purpose of making a permanent place in the computer business. In our opinion, all but three or four will fail to do so.

It is not easy to advise a client to withdraw from a market and forego what later might prove to be a substantial profit opportunity.

Our conclusion as to IBM's monopoly power was questioned by many. An editorial carried in one of our industry's foremost trade publications said that free enterprise was alive and well and innovation and superior price and product performance would tell.

Of the author's nine examples, six have been forced to withdraw from the market. Perhaps, of more importance, of the 16 companies that we had identified as serious entrants into the computer market in the late 1950's, 10 have since failed or withdrawn from the market, and of those remaining none has achieved more than a 10-percent share of the market.

Judge Sherman A. Christensen, in rendering his decision in the *Telex* v. *IBM* case—72–C–18, U.S. District Court for the Northern District of Oklahoma, September 17, 1973—said:

> The strength of competitors is relevant to an assessment of market power * * * Difficulty in entering, weakness of competing companies, and dependence of competitors upon dominant forces in the market are among the indicia of market control on the part of an alleged monopolist.

Judge Christensen went on to say:

> Claimed necessity of responding to competitive influences beyond the control of the alleged monopolist may be only its excuse for anticompetitive conduct for the purpose of maintaining or extending monopoly power or to surmount threat-

ened competition * * * monopoly is possible in a young, dynamic and complex industry, as well as in an old or static one and may be even more feasible, in special cases, through the masking of selective market strategies in the overall technological developments.

Many companies have sought to carve out a profitable niche in the general purpose computer system's market. Few have succeeded.

How is this possible in our system? It is almost inconceivable that the vast majority of these companies were poorly managed, underfinanced, or incapable of satisfying some valid customer need.

Those who have sought to penetrate the market have lost, in total, literally billions of dollars of their shareholder's money, yet their corporate power and ability ranks them among America's most successful corporations—Ford, RCA, Litton, General Electric, Bendix, Philco, North American Aviation, and Xerox—yet none has been able to reach break-even in the computer business.

One can only conclude that a formidable giant must indeed guard the gate to the computer marketplace and to the land of profits.

Fortunately, the attempts of these other companies to enter the computer market did not represent a complete loss. The industry in our Nation benefited greatly from their transitory participation.

In their efforts to penetrate the market they became the principal sources of innovation during the 1950–70 time frame.

IBM has lagged behind rather than led the technology in the marketplace. An indication of their failure to innovate is vividly shown in attachments 5 and 6 to our testimony.

Attachment 5 is the minutes of the management committee of the IBM Corp. on October 29, 1970.

The management committee is the second highest management group within the IBM organization. As you might note, in paragraph 3 of those minutes, it says:

We are very strong in the marketplace and we are continuing to use old technologies.

We believe that the control unit for the printer will pose technical problems for competition but they feel that plug to plug printers should arrive in the marketplace shortly.

These—IBM—printers, however, are predicated on older technology.

The only printer that they had at the time involving advanced technology, "has less than a 10-percent chance of being available within a 5-year period."

The next attachment, 5B, the minutes of June 14, 1958, observe, "That we were 2 or 3 years behind competition in the field effect transistor area." They indicate also some other efforts not to introduce new products that did not fit their marketing strategy.

Perhaps in the technology area, though, the most significant one is attachment 6, which is a quarterly product line assessment where IBM's management team evaluates the competitive effectiveness of their products against those in the marketplace.

They evaluate them as either being deficient relative to competition, equal, or superior. In their opinion, as of August 12, 1971, out of 67 IBM products evaluated they considered 36 to be deficient, 22 equal to competition, and only 9 superior. These documents were entered into evidence in the *Telex* v. *IBM* case.

IBM has seldom brought the fruits of their labors in the R. & D. area to the marketplace until forced to do so by competitive pressures.

IBM points to the continuing improvement in the price-performance ratio of computers as an indicia of the competitiveness of the computer market.

The facts, however, show that cost and prices have largely been lowered by conversion from vacuum tubes to solid state devices such as this committee saw yesterday.

The latter were based on research by Bell Laboratories. Similar situations may be noted in the use and application of virtual memory, time sharing, remote terminals, and most other important advances in the state of the art.

The reason IBM invents but doesn't innovate is obvious. If you rent your product, and recover your investment in x months, the bulk of the revenues derived beyond this point are pure profit.

The longer the product can be kept in place the more profitable it becomes. Under these circumstances the motivation is to maintain the status quo as long as possible, bringing a new product to market only when competitive pressures make it mandatory.

If innovation has not been the source of IBM's dominance of the computer industry, what has? Judge Christensen answered this question in part when he said in his conclusions:

> The court concludes that maintenance of IBM's monopoly power in the relevant market for plug compatible peripheral products was not the result of IBM's superior skill, foresight, or industry, and was not the result of superior products, business acumen, or historic accident.
>
> . . . It was its failure, as IBM itself recognized, to develop new technology and superior performing products as rapidly and effectively as it had hoped, and the capability of plug-compatible manufacturers to keep abreast of, and in limited instances surpass, some of the technological developments . . . that motivated it—IBM—to undertake predatory pricing and long-term leasing to stem the growth of its plug-compatible competitors.

Judge Christensen also noted,

> . . . The court infers and concludes that IBM had and exercised monopoly power. . . . Its own strategy, investigations, and planning, were premised to an important degree upon the assumption that it had such power.
>
> The very predatory intent with which . . . its strategies were planned, as well as the nature and direction of its competitive responses, strongly suggest a consciousness of market power and a determination to utilize it. . . .
>
> This is not to say that there was any ruthless or nakedly aggressive programs contemplated or carried out; anything that was done by way of strategy was sophisticated, refined, highly organized, and methodically processed and considered. But in this day and age such conduct is hardly less acceptable than the naked aggressions of yesterday's industrial powers if unlawfully directed against competition.
>
> The organized, selected, subtle, and sophisticated approach, indeed, may pose more danger under modern conditions than instantly more obvious strategy.

Senator, those are Judge Christensen's words, not mine.

If I might for a moment, though, turn to plaintiff's exhibit 67, "task force to review OEH PC file suppliers" we see some insight as to Judge Christensen's comment about carefully refined strategies.

This document, from the *Telex* vs. *IBM* case, was taken from IBM's file and sets forth the project for a task force to review its plug-compatible competitors.

You will note listed suppliers to be examined in detail were Memorex, Telex, Century, Control Data Corp. and Potter.

You will note further down, paragraph 1 in the analysis, they ask their field force to report fully on all competitive installations.

With a maintenance force that covers every IBM installation in the United States it is very simple to issue an order to go out and count competitive products.

The second page of that exhibit, numbered page 4, as entered in the court, you will notice in paragraph 5 they want an indepth financial analysis of these competitors—what is their cash flow?

And, in fact, it came out in testimony that they built a very sophisticated computerized model using all the latest techniques that examined the number of secretaries that the company might have, what their cost of goods would be, and were able, then, in turn, to look at or create hypothetical income statements and balance sheets.

They inquired into the finance company arrangements of these plug-compatible competitors. And then the question is raised under point B, what would be the effect of IBM 2314 price changes on the PCM competitors?"

And then down below they really get to the heart of it. How long can our competitors go on 2314 prices?

We go to the next page, a memorandum to a senior financial officer of IBM discussing the fixed term plan indicates that some charts were attached dealing with the presentation to the management review committee, the highest level group in IBM.

You will note on the next page, part of the flip-charts, their conclusion was that if IBM lowered their prices, their competitors would have to respond.

In doing so they would have no funds for manufacturing or engineering, and, to use IBM's terms, would become dying companies.

Although sequestered in the *Telex* vs. *IBM* case, a document was entered into the public record in the *United States* v. *IBM* case that bears upon IBM's use of a combination of sophisticated and subtle techniques in its programs to maintain absolute market control.

This memo, written by IBM's director of business practices, and discovered in the files of IBM's director of marketing, is shown as an attachment and a facsimile is reproduced.

Incidentally, Senator Hart, this is one of the 1,200 documents involved in the Judge Edelstein's contempt of court citation against IBM and his leveling of a $150,000 a day fine.

He was recently upheld by the Supreme Court, and these contested documents have now been turned over to the Department of Justice.

You will note that Mr. Faw says:

> The liability of IBM's risk lease is dependent on price leadership and price control.
>
> By price leadership, IBM has established the value of data processing.
>
> IBM then maintains or controls that value by various means: timing of new technology insertion; functional pricing; coordinated management of delivery; support services and inventory; refusal to market surplus used equipment; refusal to discount for age or for quantity; strategic location of function in boxes; solution selling rather than hardware selling; and refusal to support subsequent use hardware, et cetera.

At the bottom of the page you will note that he observed that "Legal problems are emerging as a result of certain practices which are key underpinnings to our price control."

He goes on to say:

> The key underpinnings to our control of price are interrelated and interdependent. One cannot be changed without impacting others.

These interrelationships are not well or widely understood by IBM management. Our price control has been sufficiently absolute to render unnecessary direct management involvement in the means.

The Department of Justice complaint specifically covers varying profit margins and an intensive investigation of this issue would reveal the extent of our price control and its supporting practices.

Such a revelation would not be helpful to our monopoly defense.

He suggests that if IBM's price control is seriously threatened it is necessary that IBM management fully understand how to respond.

His recommendation, which is consistent with what we have seen in some of the other exhibits, was to assemble a small, knowledgeable, secure group to think through these issues, particularly in their interrelationships, to define the emerging environment, and, in effect, develop the strategies so at the end of the *United States* v. *IBM* case all will continue to be well.

The effectiveness of these and other market control techniques has been obvious to those of us who have worked in the computer industry.

After more than two decades, IBM still holds almost 65 percent of the worldwide installed base of general purpose EDP systems.

Domestically, IBM's nearest competitor has a 9.4-percent share of the market and even this was achieved in part by acquiring GE's installed base.

The third ranking competitor, Univac, with an 8-percent share, acquired RCA's installed base when they closed the doors on their computer operation.

Senator, if IBM's control of this important industry is to be reduced it is necessary to understand how it was obtained in the first place and how it is perpetuated today.

IBM's policies and pricing in the area of computer systems is consistent with a long corporate history of exploitation of customers and the exclusion of competitors.

In the 1920's the firm dominated the market for office tabulating equipment to much the same extent it now reigns over the computer industry.

As IBM emerged as the dominant supplier of computer equipment, it again devised ingenious methods for profiting from and holding onto its monopoly.

Though the technique of tying computing supplies to computer equipment was foreclosed by IBM's earlier confrontation with the Justice Department, the same ends were accomplished through slightly different means.

The approach taken by management in the 1950's and 1960's was to refuse to sell either computer main frames or peripheral equipment outright; instead offering only month-to-month leases.

Maintenance had to be purchased from IBM.

In two ways this lease-only, required-maintenance marketing structure enabled IBM to effectively charge higher prices for computing services to high-demand customers.

First, customers with a greater need for computers would tend to want more peripheral equipment and, with a monopoly of both main frames and peripherals, IBM could—and did—charge inflated peripheral prices.

The second method of discriminating in price between customers lay in terms of the maintenance contract. More intensive users had to

pay "extra shift differentials" on the pretext that extra use resulted in added wear and tear.

In 1956 when the Department of Justice signed a consent decree with IBM, supposedly curbing IBM's abuse of its market power, the lease-only element of its marketing policies was eliminated; however, maintenance continued to be tied.

As in 1932, Sherman-Clayton had served to pry loose 1 of the 10 fingers closed around the customer's throat. Somehow the free enterprise system was supposed to loosen the others.

Once again the tenacity and creativity of IBM's management prevailed. Additional strategies were developed and implemented in order to freeze out potential competition.

The most significant anticompetitive policies through the 1960's were the maintenance lock and software bundling, the provision of operating and applications software at no extra charge to the lessees.

Both practices tended to erect insurmountable barriers to new company entry.

Until the late 1960's IBM's competitive stance was basically passive; the barriers to entry erected by long term strategies had been successful in protecting its monopoly, and the firm was rarely required to take visible offensive action against competitors.

But after the introduction of IBM's System/360, things changed.

Yesterday, as Mr. Katzenbach said, "In a competitive market if the dominant company charges excessive prices, competitors will move in and serve the market's needs."

IBM was netting 35 percent on many peripheral products. A user with an IBM, CPU was locked in because of the conversion problems.

The only peripherals it could use were IBM's. In 1967 the Telex Corp. and other small electronics manufacturers began producing equipment designed to replace IBM tape drives, disk drives, and printers.

Their products simply plugged into the IBM main frame, and were transparent to the system and to the user, hence the term "plug-compatible manufacturers."

These products, as Judge Christensen observed, in many instances were technologically superior, yet less expensive than the IBM equipment they replaced.

By 1970 business for plug-compatible manufacturers was booming. They had captured, roughly, 10 percent of the plug-compatible market; leaving, of course, the remaining 90 percent to IBM.

The IBM response was quick. A series of price cuts was initiated in 1970, which, according to internal IBM documents subpenaed by Telex in its successful antitrust suit, were calculated to kill off the plug-compatible competition.

These were followed in 1971 and 1972 with long-term leasing plans which had been prohibited for 10 years by the 1956 consent decree—but that expired in 1966—designed to further erode the viability of plug-compatible competitors.

Plaintiff's exhibit 323, dealt with the "dying company" prediction. To offset planned revenue decreases in the peripherals area, IBM raised main frame prices to maintain IBM's average profit at 32 percent.

Judge Christensen, in his September 1973 decision characterized IBM tactics as "* * * unlawful predatory conduct * * * intended to * * * maintain its monopoly position."

The effect of IBM's moves on the plug-compatible competitors was devastating. Telex, for example, lost over half its sales from 1971 to 1972, and has yet to operate profitably since the IBM attacks. The same can also be said of Memorex.

The long IBM history of employing marketing strategies which exclude competitors with a view toward maintaining its monopoly power and profits is a textbook case of the abuses the authors of the antitrust statutes intended to prevent.

When unchecked IBM complacently reaped the fruits of monopoly; when callenged it responded with vigor to bring competitors, no matter how small, to financial ruin.

Traditional antitrust enforcement, as was noted yesterday, has focused largely on eliminating blatantly illegal practices such as collusion in restraint of trade, reciprocity, below cost selling, price fixing, and other such obviously unethical practices.

Perhaps it has been the failure to understand that the modern day monopolist employs a variety of far more subtle techniques to maintain his monopoly power that has caused the Department of Justice to miss the target on two prior occasions.

Some of the more subtle techniques, as Mr. Faw has so helpfully pointed out in his " 'Thoughts for Consideration,' * * * solution selling rather than hardware selling * * *" is a key underpinning of IBM's monopoly power.

At the very beginning of the design cycle the architecture of an IBM system, including the interconnection and interactions between each of its separate functional parts, is structured to achieve efficient data processing and to lock the customer into IBM products and services.

This technique is employed in the design of the logical, mechanical, and electrical interfaces between the central drives, memories, and printers.

It is also used in the design of the software that operates the system.

Several examples serve to illustrate the interaction between architecture and monopoly power with the introduction of the IBM 370 family of computers, IBM standardized—internally—in the interfaces between its central processing units and its peripheral devices. This move briefly increased the computer's flexibility by allowing him to replace various devices as his needs changed.

In 1969, however, IBM realized that many customers were interconnecting peripheral devices produced by other suppliers—devices that were superior in performance and lower in price than the IBM equipment—and they took steps to remedy the situation.

As one of several strategies aimed at stemming the competitive tide, IBM moved the electronic controller out of the peripheral device and into the computer main frame.

This forced competition to redesign its products, but furthermore, restricted their opportunities to innovate in the electromechanical design area.

Because IBM hardware interfaces are kept secret until first product shipment, a user or a competitor wishing to interconnect must obtain

the new product, reverse engineer the interface, and then design their device so that it works properly with the host IBM computer, obviously losing valuable time.

It is this that IBM's marketing force uses to sign up customers on 1- or 2-year contracts.

When the competitor finally gets to the market he finds that it is foreclosed.

The recent *Bell & Howell* vs. *Kodak* case hinged on Eastman's use of the camera-film interface to obsolete competitive products and bring new systems into the market while foreclosing competitive response.

In this instance, in order to settle a private antitrust suit, Kodak agreed to disclose, 18 months before the first shipment, the specifications of any new film product, a market in which Kodak is alleged to possess monopoly power, to qualified camera manufacturers who requested the information.

A similar provision in the computer industry would be one significant step in reducing IBM's monopoly power.

Another block is in the software area, the instructions that tell a computer what to do. An article from this month's Datamation, shown as attachment 8, entitled "IBM's Operating System Monopoly" sets forth how IBM uses system software to lock out competition.

If I might quote very quickly, the author notes that:

> "IBM currently monopolizes the development and support of IBM operating systems.
>
> This monopoly, which started almost 10 years ago, has played continuous havoc with IBM 360 and 370 users.
>
> In 1970 the operating systems were the one piece of software that IBM chose not to unbundle. Was it an act of kindness?
>
> Competition does not happen spontaneously, especially in the area of operating systems. Some software companies can "pick up the crumbs." However, there is no effective or economical way for a would-be competitor to break into the field.

It is an interesting article and I suggest, when you have time, you read it.

By including software in the price of a system, competitive offerings are foreclosed. Moreover, by bundling the operating system with the central processing unit, IBM maintains absolute control over the useful life of both the software and the system.

For example, this control was recently used to disconnect competitive terminals from IBM systems. Terminals generally interconnect with a computer system over telephone wires—a standard interface available to all.

Thus, independent terminal manufacturers were permitted entry into this market. Soon a variety of superior price-performance products became available.

When faced with the growing success of the independent terminal manufacturers, IBM simply announced that they would no longer maintain the software necessary to allow non-IBM terminals to interact with IBM computers.

The mere announcement of this move severely impacted sales, profits, and access to capital of the targeted competitors.

IBM's ability to unilaterally set de facto standards for the various media used to record computer data provides yet another form of market control.

To make matters even worse, IBM also refuses to sell—at any price—the calibration tapes and disks needed to insure compatibility when media produced by others is used.

As we recently testified before the House Commerce Committee on hearings on the International Voluntary Standards Cooperation Act—H.R. 7506—standards are employed in many industries as a market control technique, but in our industry the dominant company resists the development of standards because their employment would unlock a major element of their market control.

So far, we have looked at anticompetitive strategies dealing primarily with the design and production of the computer itself.

Other, even more subtle, strategies depend upon when IBM does things and on what they tell their customers.

As noted earlier, IBM's director of marketing practices characterized the timing of new technology insertion as one of the key factors underlying the company's control over the value and cost of data processing.

As the dominant force in the industry, IBM carefully controls the level of technology available to the user. Their motivation is obvious—nothing can be allowed to prematurely obsolete equipment IBM has out on lease.

No innovator in our market, because of IBM's enormous prestige, image, and market share, can successfully introduce a new concept in computer technology unless IBM supplies its seal of approval by announcing a similar product.

Without IBM's blessing, the product or concept is doomed to be a commercial failure regardless of its intrinsic or economic merit.

On the other hand, this means that it is next to impossible for a competitor to gain commercial acceptance of an innovation ahead of IBM.

On the other hand, IBM can, and does, use "artificial" innovations to stifle competitors. By moving an interface, shifting the location of a controller from peripheral to main frame, changing a communications protocol, or some similar "improvement," IBM can effectively obsolete any competitive product it wishes.

This ability to introduce new products, media, or approaches that completely changes the rules of the game without warning is another element of IBM's monopoly power.

In this way IBM is able to keep all of its competitors off balance, force them to spend excessive amounts of development dollars to catch up, and squeeze them into a position where the competitor must recover his investment and his profit, if any, in 3 or 4 years, while IBM can recover its in 5 or 6 years.

To a layman this much market control on IBM's part may well sound inconceivable. However, the well cultivated IBM image coupled with the lack of sophistication on the part of the consumer—again, a fact of life in our industry that has been a carefully nurtured byproduct of IBM's dominance—makes it not only conceivable but nearly insurmountable.

Many of the advances in our industry have been made by the smaller competitor who substituted a new, lower cost component or subsystem for an older design; for example, substituting semiconductors for core memories or providing off-line capabilities in a printer controller so

that it does not use CPU time. Although I did say that such innovations can be freely brought to market, I did not say that IBM would allow them to become commercially successful.

When a change in standards, hardware or software interfaces, prices, or the timing of new technology insertion fails to keep one or more competitors in their proper place—small and weak—IBM has two additional trump cards to play.

The first involves notifying the customer that IBM cannot, or will not, provide field engineering support or maintenance of the computer so long as a competitive device is attached to the system.

This strategy has been used extensively, and I might say, very effectively, against the vendors of add-on memory subsystems.

Since I wrote this, the front page of Computer World this week came out with a verified report that in the State of Massachusetts IBM salesmen were sending out letters to 370 135 users suggesting that there is no such thing as a plug-compatible memory and that IBM probably would not maintain their computer if they bought a competitive product.

This is, according to IBM's acknowledgment, totally contrary to corporate policy. They don't understand how it happened, and so forth.

It is the third instance of this in our industry in 2 years.

The "refusal to maintain" strategy lacks credibility in those cases where the competitive device is not physically integrated with the host computer, the computer terminal, for example.

IBM has recently begun informing customers that IBM cannot or will not guarantee the performance of the system if a non-IBM device is used in conjunction with it.

A recent, rather blatant, example of this ploy was in California's Teale Data Center Procurement where IBM simply put the caveat in as part of their proposal.

I've discussed a number of the strategies employed, singly and in combination, by IBM to maintain its market control and to suppress competition.

Unfortunately, time and space limitations prohibit detailing the literally dozens of other anticompetitive strategies that IBM employs.

This does not imply that the latter are any less effective than those discussed above. Many of them are classic monopoly tactics.

For example, the use of long-term leases with punitive cancellation penalties to foreclose competition; the lowering of prices on products where they face competition coupled with compensating price increases on products where competition is not a factor; the announcement of "phantom products" to block legitimate competitive offerings; refusals to deal—for example, IBM will not sell components or subassemblies to other manufacturers at any price; the intentional withholding of planned product improvements—for later introduction as mid-life kickers—all calculated to obsolete competitive products without impacting IBM's own inventory; and lastly, reciprocity.

Virtually all of the strategies I have mentioned are encompassed in the 15 private antitrust suits and the Federal antitrust action now pending against IBM.

Attached to my testimony are a number of documents taken from both the *Telex* and *Greyhound* v. *IBM* cases. To me they clearly docu-

ment some of the attitudes and decisions of IBM's top management committees and, if I may say, quite a bit of arrogance.

[See exhibit 1 at the end of witnesses prepared statement.]

Mr. BIDDLE. After reading these and other IBM documents now in the public record one cannot avoid believing that Judge Christensen's finding and Mr. Faw's memo as to the source of their monopoly control comes much closer to the truth than do the protestations of their attorneys.

The latter contend that IBM is besieged on all sides by more than 1,000 able competitors and is watching its market share decline from its already paltry 38 percent.

One may well ask, if this contention is true, how is it that not one single entrant into this market in the past decade has achieved revenues that even approach 1 percent of IBM's?

Is there any doubt as to why the members of our industry petition the courts and the Congress for relief?

The fundamental intent of our Nation's antitrust laws is to protect consumers not competitors. One may well ask, how has the user of computers and of data processing services faired during these past two decades of IBM monopoly control?

As I noted earlier, IBM's key underlying competitive strategy has been to maintain maximum product differentiation, to avoid any meaningful industry standardization, and to provide upward mobility within its own line.

Whether the early computer user started with an IBM punch card accounting machine, or by having his data processing work done by the IBM Service Bureau Corp., or by renting his own computer, he soon found that conversion to a competitive system was virtually impossible.

IBM software is so intertwined with its operating and data storage systems that they cannot easily be separated. One user, testifying in the *Telex* v. *IBM* case, indicated that the problem of converting from an IBM system to a competitive system was so complex and, therefore, so risky he would not change vendors despite almost price/performance advantages that might be available.

A variety of strategies have been employed by new entrants to this market in their efforts to penetrate this barrier.

The limited penetration they have achieved in their relatively stable market shares over a 20-year span would indicate that no strategy has succeeded.

The level and quality of IBM's service and support and their carefully nurtured image, have kept the user reasonably well satisfied and passive.

Of course, few users have any idea of the costs and penalties, the withheld technology, and the behind-the-scene practices being employed to keep competitors in line.

The user in our industry has little idea of what his world might be like if there were, in fact, true competition for his business.

Only in recent months, as a result of *U.S.* v. *IBM*, *CDC* v. *IBM*, *Greyhound* v. *IBM*, *Telex* v. *IBM*, and other antitrust suits, has the computer user begun to see the scope of IBM's control over his destiny.

Even so, he remains largely passive. Perhaps because this is the way it has always been.

In my opening remarks, I noted that the IBM Corp. has an awesome amout of economic, market, and political power.

I hope that I have been able to provide this committee with some insights into the extent of this power and its sources.

This one company can, if it so chooses, bring the economy of America to a grinding halt. Its self-perpetuating management answers to no one.

The controlling shareholders care very little about what management does or how they do it, so long as they keep piling up profits.

Their employees are well taken care of and happy; their customers are passive; their competitors impotent.

There are no checks and balances.

Our European and Asiatic trading partners recognize the import of what I have reported here. They, too, fear total IBM dominance.

At present they are striving to stem the tide by pouring massive subsidies into their indigenous computer industry.

So far, it has done little to shake IBM's hold on their computer industries. Gradually, nontariff trade barriers are being erected in the hope that the American stranglehold of their industry will be broken.

To date these NTTB's have impacted the exports of U.S.-based manufacturers; however, it has had little effect on IBM.

Our Government moved to remedy this problem on the last day of the Johnson administration. Almost 6 years have elapsed.

During this period IBM and its attorneys have used every conceivable tactic to delay its coming to trial. Well they might, for their net aftertax profit per day is $4.5 million.

They have been chastized by two Federal judges for destroying the index to evidentiary material prepared by Control Data.

They have been held in contempt of court for refusing to turn over documents; and they have created diversion after diversion.

Two appeals to the Supreme Court have been denied, and now, 3 months before the trial is to start, they are laying the groundwork for another.

Each day's delay is worth $4.5 million net aftertax profits, so why not drag it out?

Clearly they have the ability to do so. The defendant's legal staff outnumbers that of the Department of Justice by more than 10 to 1.

Obviously, in a case involving depositions of more than 1,000 companies, over 500 witnesses, and some 1,500,000 pages of evidentiary material, this imbalance gives IBM a distinct advantage over the Antitrust Division of the Department of Justice.

In the meantime the capital markets have turned their backs on all but a few industry participants. Many have concluded that IBM's market power will not be curbed and that its control over competitors will remain unchecked.

The refusal to invest in IBM's competitors makes predictions of their demise a self-fulfilling prophecy.

Even now IBM is putting the finishing touches on its 1977 product line. If the internal documents now in the public record are at all indicative, the strategies are already in place to insure a continuation of IBM's market power and control for many years to come.

Relief from the IBM monopoly will not come from the application of backward-looking antitrust concepts and simplistic relief plans.

Imaginative solutions must be developed—solutions that bring the benefits of free and open competition to the computer marketplace and that serve the best interests of our industry, the investment community, and the public.

We do not wish to see IBM punished. They have made invaluable contributions to our industry and to our Nation. We do not wish to see them regulated like A.T. & T., for this would stifle their creativity and skill.

However, we do believe that it is essential that their unilateral control over the computer and data processing industry be ended completely.

Should the Congress fail to deal effectively with monopolization of the computer industry, the Nation will be exposed to potentially massive economic harm resulting from unfettered abuse of the dominant firm's market power.

IBM has already shown itself perfectly willing to sacrifice near-term profits to bring competitors to financial ruin, thus insuring its monopolistic prices and profits over the long run.

Eventually, potential challengers will realize the pure folly of attempting to introduce even technologically superior, lower cost products in an environment of predatory IBM responses.

When potential competition is exhausted, when even the RCA's and GE's fear to tread upon IBM territory, the only remaining check upon IBM behavior will have disappeared.

The threat of eroding market shares serves as a powerful force, spurring firms in other industries to make technological improvements, keep prices at a reasonable level, and generally respond to customer needs.

For IBM, that threat will no longer be real, as potential competitors will fear the financial consequences of challenging IBM dominance.

America will then be faced with an unthreatened one-firm computer industry as complacent, as uninnovative, and wasteful as the legally monopolized telephone industry has already been allowed to become.

Thank you.

Senator HART. I'm sure your last statement is not universally agreed to.

Mr. BIDDLE. As you know, Senator, we presented a statement to this committee with our thoughts on the telephone problem.

Senator HART. That exhibit that you cited to us, that is your attachment 6, where it is a breakdown of some hundred-odd products. That is an IBM evaluation of the quality of their products against their competitors.

Mr. BIDDLE. Against those of their competitors.

Senator HART. Our tally shows that IBM judged their product to be deficient compared to those of competitors, 36 times; equivalent to their competitors, 22 times; and superior to the products of their competitors, 9 times.

How representative a product listing is reflected in those hundred-odd items?

Mr. BIDDLE. Well, as we scan through it, virtually all of their "systems" reflect their small systems and their small scientific systems.

Page 8 represented not only tape and disk products in the marketplace and storage products but even unannounced products. You'll notice their FIR project—and they assign this type of a name as a confidential preannouncement handle—was equal even before it was announced.

One of the interesting things to observe in this document is that IBM contends in all of the antitrust cases that there is no way to define the market.

And yet, if you will notice, even the table of contents of this internal document, which is produced quarterly and has been for years, defined the markets very neatly: Large systems, intermediate systems, small commercial systems, peripheral products.

And yet, in Tulsa, they allege there is no such market as peripheral products. So this represents their full product line.

Now, actually, these are simply the summary sheets of a document that is about 200 pages thick and goes in considerable detail.

Senator HART. The reason I was struck by that is that one of the basic, almost primitive, notions we have about a competitive society is that one is rewarded in proportion to the quality of his products.

And the argument goes, "Why crucify me just because I am good?" It was for that reason that I was struck because this would suggest that whatever the reasons for the preeminence of this producer, in his own judgment, it is not the quality of his product.

Mr. BIDDLE. That's correct. And you will also note it was not his low prices. If you look at attachment 11, that is simply the profit and loss statement for a single product; the net aftertax profit is predicted to be 35 percent.

[See attachments to exhibit 1 at the end of witnesses' prepared statement.]

Mr. BIDDLE. Perhaps attachment 9, plaintiff's exhibit 472, gives us a clue. This is a letter from Mr. T. V. Learson, the president of IBM at that time, to one of their financial executives, where he says:

> Group is looking forward to a profit at 48 months of some 35 to 38 percent on memory with a profit of 25 percent on the central processing unit.
>
> At the above profit level for memories, Group estimates they will be 30 percent above competition in price.

He says, "Originally, I advised on the price memories of CPU's both at 30 percent." They readily agree that CPU's cannot be easily duplicated.

What he is really saying is that it cannot be replaced because of the software lock whereas memories can be.

> I conclude that we should have a 25-percent profit on memories and raise the price on our CPU's so that we have an overall 32 percent.

The classic monopoly tactic of lowering prices where you face competition, raise them where you are protected from competition.

Mr. O'LEARY. Mr. Biddle, in your statement you say—and I am quoting:

> The most significant anticompetitive policies through the 1960's were the maintenance lock and software bundling; the provision of operating software with no extra charge to lessees. Both practices tend to erect insurmountable barriers to new company entry.

You are saying in effect that any competitors had to offer the full range of those products and services?

Mr. Biddle. Yes.

Mr. O'Leary. For the record, would you describe the difference between operations software and applications software?

Mr. Biddle. I think, as Control Data explained yesterday—and I'm not a technician; my 20 years has been spent on advising corporate managers how to be monopolists until the last 2 years—the operating system are the internal instructions that direct a computer in a housekeeping sense.

It controls the use of peripheral devices; it basically provides all of the machine interfaces without reference to a specific application; whereas the applications software is the software that does the payroll, or calculates taxes, or performs a specific task.

Mr. O'Leary. Some of these things are more related to the making of the CPU than others; is that not correct? For example, the operations software.

Mr. Biddle. The operating system is an integral part of the architecture of the CPU or it can be made so. It can also be made independently of the CPU if you know the specifications of the CPU.

Mr. O'Leary. And at the present time are these items bundled together by IBM?

Mr. Biddle. Yes; they are.

Mr. O'Leary. You described with reference to Mr. Learson's memo, cutting prices on products facing competition and raising them on the CPU where there is less competition.

You also indicated that IBM instituted long-term leasing plans for plug-compatible products. I take it this is what is referred to by the fixed-term plan?

Mr. Biddle. That's correct; fixed-term plan and long-term plan.

Mr. O'Leary. Would you describe what the terms were prior to the institution of the fixed-term plan and what they became afterward?

Mr. Biddle. Well, prior to the introduction of these plans it had been IBM policy, basically, to rent all equipment on a 30-day-notice basis.

As competitors became successful, IBM introduced the extended-term plan, the fixed-term plan, which gave the customer a significant discount. I think it was 8 percent and 16 percent.

And in turn it had substantial cancellation penalties if he canceled before it expired. They also, though, came up with a creative little kicker that allowed that to be extended on a month-to-month basis. As I indicated in my testimony, when IBM comes into the marketplace on a surprise basis with a complete change in design, the competitor must then—or even the user if he is a sophisticated user and trying to interface his own system—get in line to get delivery on a system, wait for delivery of the system, take electronic instrumentation and reverse engineer it; then develop the interface so another device can effectively work with that system.

And by that time they've locked up the marketplace.

Mr. O'Leary. Now, I want to move on to another problem. You also indicate that IBM moved the electronic controller out of the peripheral device and into the computer main frame.

A phrase in Mr. Faw's memo caught my eye in that respect, "strategic location of function in boxes."

Are you saying that IBM took something that was previously outside the box and put it inside the box so there is no longer anything to plug into?

Mr. BIDDLE. In effect, yes. In Judge Christiansen's findings he observed that in moving the controller out of the peripheral it achieved two things; actually, it achieved three.

One, it reduced the value of the peripheral product in the marketplace because the electronics represented a significant portion of the cost and the profitability; moved it into the main frame—"under the covers" is the term that is used—leaving the peripheral manufacturer the option of basically making an electromechanical device that takes its instructions from the CPU.

The net effect of that is that it restricts the peripheral manufacturer's opportunity to be innovative in the way he does his electromechanical design.

And, frankly, in data processing today that is one of our major remaining areas for breakthroughs, higher speed printers, higher speed tape drivers, and so forth. IBM has preempted that.

The other is that the customer—at least when this initially happened—wanted the benefit of a competitive product and the competitive controllers flexibility, but in effect the customer is forced to buy two: The one that came with the CPU and the one that did not.

The minutes of IBM's management committee indicate that future strategy will exploit this more and more because—and I can see why—in *Telex* v. *IBM*, Judge Christiansen set out injunctive relief that could have helped unlock this industry.

And Mr. Katzenbach managed to convince Judge Christiansen that there were technological necessities that justified eliminating that injunctive relief.

I consider Judge Christiansen a very wise man, but I also do not think he fully understands the design of a computer well enough to understand that that technological necessity is more myth than fact.

Mr. O'LEARY. How is the user supposed to be better off by taking things which are outside of the box and putting them inside?

Mr. BIDDLE. Frankly, I do not know. The only person I know that is better off in that practice is IBM.

Mr. O'LEARY. You go on to discuss IBM's hardware interfaces and the fact that they are kept secret until the first new product shipment and describe the lag time before a competitor can catch up.

How would standards help alleviate that problem, if at all?

Mr. BIDDLE. Well, Mr. O'Leary, CEBEMA, the other trade association in our industry, is secretariat of the X-3 Committee of the American National Standards Institute.

For 6 years, this committee had been working on the development of an I-O interface standard so that all manufacturers would be working to a common standard for the benefit of the user.

In that 6-year period there had been relatively little progress. And, in fact, they had taken a U.S. position that we would resist further efforts by the International Standards Organization to develop standards in this area.

Our association intervened, and at the moment it looks like we are making progress in this area. However, let's be frank: IBM has a lot to lose if there were standards.

As we indicated in our House Commerce Committee testimony, the small company is very much hampered in the standard making process because it is costly, but even if he can succeed in pushing for a domestic standard, IBM's participation in the standards-making bodies from all free world countries that participate on the international level allows them to block us there.

This is not a national problem, it is an international problem. The lack of standards has been used in our industry as a monopoly tactic.

Mr. O'Leary. Mr. Faw's memo talks about how IBM has established the value of data processing usage and how it controls value. It then makes reference to timing of new technology insertion.

You discussed both the power of IBM's image and the alleged use of artificial innovations. Can you give me an illustration of what you mean by "artificial innovations"?

Mr. Biddle. As I prepared my testimony I had half a dozen in mind, but they escape me at the moment. If you would address that question to Dan McGurk tomorrow, or if he can come forward, I think he might be able to respond.

Mr. O'Leary. You obviously feel that IBM has enormous market power. Is the key to that power the fact that it is in a number of interrelated markets, main-frame support services, software maintenance, all of them put together?

Mr. Biddle. Yes, it certainly is. And with their recent announcement in the Comsat area, it indicates they plan to be in some more.

There is—I believe—a memo that sheds some light on that subject. I don't find it at the moment but there is a memo in the files, the public record, from, I believe, Mr. Learson to, in effect, his management group that puts them down rather severely for thinking that they could be selective in terms of what market share they would hold in each market segment.

And concluded, and so told them, that you cannot be selective: you must go for our fair share in all market segments.

And as you read their material it is obvious that their concept as to their fair share of the market is 70 percent. Anything less is unacceptable. I suspect they feel that anything more would bring down antitrust suits.

Our concern is that the antitrust suits will be resolved years into the future. In the meantime, the damage is done. Momentarily, the 10th circuit is to hand down a decision on IBM's appeal of the Telex decision.

In my opinion Telex will win. And perhaps one day, after it has been fought to the Supreme Court, they'll get some $250 million.

Nevertheless, they have been driven out of the computer business.

I suspect, if we are to look at IBM's documents, we would find that that $250 million is substantially less than the profit loss they predicted if they did not drive Telex out of business.

Mr. O'Leary. Thank you, Mr. Chairman.

Mr. Biddle. I might say, Senator, it was suggested yesterday that there would be some mistruths in my testimony. If there are any then I must say that the mistruths be in IBM's own management documents, because my entire testimony has been drawn from their records.

Senator Hart. Mr. Chumbris?

Mr. CHUMBRIS. Mr. Chairman, in view of the discussion on the proposed postponement of the case from this week until October, and the fact that there is a matter pending before the Federal court in October, we feel that we should be very cautious in asking any questions during the course of these hearings unless there is some item that should be brought into focus.

In view of that, we will let each statement be made for the record. If there are conflicts in the discussions, the conclusions and the statements, those will be brought out at the proper time by appropriate witnesses.

Thank you.

Senator HART. Thank you very much.

[The following was received for the record.]

MATERIAL RELATING TO THE TESTIMONY OF A. G. W. BIDDLE

Exhibit 1.—*Prepared Statement of Mr. Biddle*

STATEMENT OF THE COMPUTER INDUSTRY ASSOCIATION AS SUBMITTED BY A. G. W. BIDDLE, EXECUTIVE DIRECTOR

We appreciate the opportunity to appear before this committee to present testimony on an issue of critical importance to our industry and to our nation. As this committee knows, we came to this committee and asked to be permitted to represent the views of our member companies. Since its inception, there has been but one voice speaking for the computer industry—IBM. There are, we believe two sides to the question before this committee. I thought we had leaped ahead a decade to 1984 yesterday when Mr. Katzenbach suggested that this committee should only listen to the views of those who agree with IBM.

The Computer Industry Association represents forty member companies with combined annual revenues in excess of $1.5 billion and employing more than 40,000 people. Our individual member firms range in size from under a million dollars in annual sales to something in excess of $200 million. (A list of our member firms is shown on Attachment 1. Their products cover the full spectrum of goods and services associated with computers and data processing—mainframes, memories, tape drives, disc drives, printers, data entry devices, terminals, software, and services such as leasing and systems consulting.

The Association was formed two years ago this month. It's objective then and now is to endeavor to bring about free and open competition within the computer and data processing industry—an industry that has, since its inception, been dominated and controlled by one company—IBM.

In many respects, our Association was born of frustration. Its founders had come to realize that no matter how superior their technology, or how good their product, sales and service, their existence as viable companies would remain at the sufferance of the industry giant. They realized that efforts to build an enterprise on industry, skill, and foresight could be thwarted by a mere rumor that IBM was going to announce a new product; or by a change of an IBM hardware or software interface; or by some other unilateral change in the rules of the game—and that they could do little or nothing about it.

Our founders frustrations ran even deeper. They had lived through one federal antimonopoly suit against the giant, only to see it result in a consent decree that did little to reduce the defendant's market share or power. And, although another suit was filed on the last day of the Johnson administration, for more than three years nothing had happened to bring it to trial.

Out of this frustration came a plea—a plea that must be answered soon if we are to see a restoration of faith in our form of government and our free enterprise system. Are we going to allow, as a conscious decision of public policy, an ever increasing concentration of economic, market, and political power among fewer and fewer large institutions, or are we as a nation going to return to the philosophy of free enterprise and pluralism? If the answer is a reasoned decision that monopoly is the wave of the future, we ask only that the rules of the game be made clear. Only then can our member chief executives make those decisions that serve the interests of their customers, employees, and shareholders.

If, on the other hand, we as a nation believe in the concept of competition and in the benefits of a free enterprise system, then we must take steps to make that system work. The legislative mandate must be clarified and the enforcement machinery modernized and streamlined. The rules of the game must be set out for all to understand. The entrepreneur must be able, once again, to succeed—or to fail—on his own merits. He should not be kept in business through governmental intervention if his activity is not providing economic benefit—nor should he be put out of business by a monopolist when his existence benefits the consumer and the nation.

We believe that free and open competition between *near equals* is good for producers, consumers, and the economic health of our nation. That others share this belief is borne out, in part, by the fact that our membership has increased by a factor of five since we appeared before this committee one year ago.

Since that time a lot has happened. CIA activities—STDS, etc. IBM was found guilty of monopolization and attempt to monopolize by a Federal District Court in a private antitrust case and preparations for the trial of U.S. vs. IBM have accelerated with the trial due to begin this October. In the meantime, IBM has become more, not less, aggressive. Their unilateral control of the market place remains intact and the prospects for near term relief for our industry continue to be dim. The fact that this committee is holding hearings on this critical industry is encouraging, as is the fact that the House and Senate have acted favorably on the Antitrust Division's budget request. However, for the problem before us to be solved, it must first be understood. In the hope that we can contribute to the deliberations of this committee, we would like to make the following key points.

1. The computer has quietly revolutionized life in America. In doing so it has become the central nervous system of our entire economy.

2. The computer industry is dominated and controlled almost in its entirety by one company—IBM. The extent of their monopoly control is second only to that of AT&T's over the telephone industry.

3. The maintenance of their monopoly control is based upon a number of interlocking strategies—some subtle—some nakedly predatory.

4. IBM's continued control over the computer industry enables it to control the central nervous system of our nation's economy representing a real and dangerous threat to the United States.

5. The elimination of monopoly power and control of this industry requires an understanding and appreciation of the strategies and techniques used to maintain it.

6. Our present antitrust laws and enforcement procedures appear unable to effectively deal with the problem.

The reasoning underlying these conclusions follows:

THE COMPUTER REVOLUTION

The first commercially built electronic computer—the Univac I—was delivered to the Bureau of the Census in 1951. The event was heralded by many as the dawn of a new age—an age in which workers would be replaced by machines; computers would do the menial, repetitive and dirty work, freeing man for more productive activities and almost endlessly expanding his capabilities, but some foresaw mass unemployment and increasing dehumanization as an inevitable byproduct of this new technology.

In little more than two decades the computer has, in fact, had major and far reaching impact on our nation and our way of life. To a large extent the computer has made advances in other technologies possible. It *has* taken over the boring and repetitive tasks and freed man's hands and mind for more creative work. Moreover computers have made seemingly impossible tasks not merely possible but simple. And contrary to the expectations of some, the computer has not created widespread unemployment, but has in fact created jobs through its contribution to our overall economic growth. As each day goes by, new applications are found for these wonderous machines—new tasks are performed with lightening speed and accuracy.

In many respects this revolution has occurred quietly. Few of us ever see a computer. We are almost totally unaware of the literally thousands of computers installed and operating in our country today. They sort our mail, schedule our airlines, process our checks, control our electric power, print out our paychecks, and calculate our bills. Wall Street, the federal government, the

defense establishment, our transportation system, our banking system, our utilities, and our manufacturers are *totally dependent* upon the continued operation of their computers.

It has taken us two decades to convert from clerks and reams of paper to the high speed processing of millions of pieces of information contained on a single magnetic tape or disc. The task of reversing this process, should it ever become necessary, would be virtually impossible. There is no going back. Today, the smooth functioning of our nation's economy is synonymous with, and wholly dependent upon, the smooth functioning of our installed base of electronic computers.

Unfortunately, a situation has developed that threatens the operation of this key national resource. The problem is similar to one that existed in the early days of railroading—each line used a different track gauge. As a consequence, freight moving across the country had to be off-loaded and reloaded at each interchange point. The lack of a standard gauge made it impossible to interchange cars and shift motive power as needed.

In the computer field, the lack of standards has made the interchange of equipment and media between systems almost as difficult and inefficient. Few people not intimately involved with our industry, are cognizant of the fact that each computer center is unique unto itself. The specific combination of hardware, software, operational procedures and practices in use serves to individualize the data files to the point that an alternate or backup computer capable of processing that center's files rarely exists. In essence, if the computer doesn't run—the company or entity doesn't function. There is simply no way to borrow the computer next door. This is equally true of an auto manufacturer's assembly line, an airline's reservation system, or a Federal Reserve Bank's clearing operations. In each instance they must rely upon their computer system supplier for system service and support. There is no other alternative.

America's Juggler

The significance of what I have described above becomes clear when one realizes that 7 *out of 10* computers in America today are owned and serviced by one entity—IBM. If, for the sake of illustration, their field service organization were "unavailable" for two weeks, our nation would slowly and inexorably grind to a halt. The transportation system, the banking system, the communications system, and the Fortune 500 manufacturing companies would all cease functioning—layoffs would be in the millions—creating chaos almost beyond comprehension.

Personally, I know of no other single corporation in the world with this much potential power over a nation's economy. Although they surely wouldn't abuse it, the very possession of this much power in the hands of a few people is frightening. It is all the more so when one realizes that few Americans—including their representatives on Capitol Hill—even know that it exists.

STRUCTURE OF THE COMPUTER INDUSTRY

It is, I believe, important for the Committee to understand how this situation came about. The computer industry can be a classic case study through which some lessons might be learned about the monopolization of high technology industries and some insights gained as to the effectiveness of existing antitrust laws in our present environment. Tomorrow, my colleague, Dan L. McGurk, will comment on some actions that this Committee and the Congress might take to rectify this situation.

Punched Cards to Computers

Although most people associate the beginnings of the computer industry with the first commercial Univac I, the data processing industry as we know it is an extension of the punched card tabulating machine industry—an industry that goes back to the 1930's.

Judge Earl R. Larson, in deciding the Honeywell, Inc. vs. Sperry Rand case (civil action 4–67 Civ 138, United States District Court—4th District Minnesota) recognized the transfer of market control that took place during the transition from punched card equipment to digital computers.

In his Findings of Fact and Conclusions of Law, Judge Larson said:

> 15.14.1 In 1956, IBM was recognized as the principal U.S. supplier of 80 column TAB card equipment and SR (Sperry Rand/Univac) as the principal U.S. supplier of 90 column TAB equipment; both of these

companies had years of experience and know-how, both in design and production areas.

15.14.2 The tremendous customer base which IBM had because of its domination of the tabulating industry had a good deal to do with its position in the early days of the EDP industry, and this, combined with the information exchange, gave them the predominant role which has tended to perpetuate itself.

15.14.3 IBM used its dominant position in the tabulating business—particularly its large sales and service force to quickly seize the lead in the EDP business.

15.15.1 In terms of total revenue (stated in dollars) and market share (stated in percent of revenues of the entire industry), SR and IBM had the following shares of the EDP market in 1956:

	World market		Domestic market	
	Amount	Percent	Amount	Percent
IBM	$42,174,000	42.9	$39,276,000	47.5
SR	50,329,000	51.2	37,590,000	45.5
IBM and SR	92,503,000	94.1	76,866,000	93.0

15.17 In 1956 IBM shipped about 85% of all new business and SR about 10%.

15.18 At the end of 1956 IBM had 75% of all EDP systems outstanding and SR 18%.

Against this background, it is important to note that the Department of Justice filed an antitrust suit against IBM on January 21, 1952. The Government suit charged IBM with monopolizing the tabulating machine industry and with engaging in various restrictive practices in the conduct of its tabulating machine business.

At the time the Government action was filed and for some years thereafter, IBM had about a 90 percent share of the tabulating business and Remington Rand the remaining 10 percent.

On January 25, 1956, the United States District Court for the Southern District of New York approved a consent decree entered in the case of United States vs. IBM. The decree contained numerous remedial provisions directed at the IBM TAB monopoly and to a limited extent at its rapidly growing EDP monopoly.

In retrospect, it is clear that the Department of Justice failed to realize that IBM's monopoly of the TAB market had already served its purpose. It provided them with a massive customer base which could be converted over to computers and in turn allowed them to escape from the more onerous provisions of the consent decree.

Clearly, IMB's monopoly control was not shaken. On page 157 of his decision (shown as Attachment II), Judge Larson presented statistics on the retail sale value of the installed base and the market shares of each of the major participants in the EDP industry during the period 1955 through 1967.

During this period IBM's share fluctuated between 65% and 78%—the combined shares of IBM and Sperry Rand-Univac ranged between 77% and 95%.

Competitive Forces At Work?

It should also be noted that some very able and well financed companies took an active interest in the computer industry during this period. My first assignment when I joined the professional staff of Booz Allen & Hamilton as a consultant in 1958 was to examine the computer market for the Bendix Corporation. At that time, the EDP market appeared to be a highly competitive one and a number of companies were seeking to establish themselves. A partial list included:

Sperry Rand-Univac
Radio Corporation of America *
General Electric Co.*
National Cash Register Co.
Minneapolis Honeywell Regulator Co.
Burroughs Corp.

Philco Corp.*
Bendix Corp.*
Royal Precision Corp.*
North American Rockwell-Autonetics *
Control Data Corporation
Digital Equipment Corp.
Eltronics Inc.*
Monroe Calculating Machine Co.*
Packard Bell Electronics *
Thompson Ramo Wooldrige Inc.*

The *U.S. vs. IBM* consent decree had been signed and heralded as a significant step towards establishing competition in the computer market place. Meaningful competition, however, did not develop. As shown on Attachment 2, no IBM competitor but Sperry Rand, attained more than a *5%* share of the installed computer base thru 1967.

Most of the companies enumerated above had substantial resources; most were already major factors in markets that would, in time, become directly involved with computers. As a result they *had to* enter the computer market and prosper, if only to protect their established positions.

In late 1960, I was again asked to examine the computer market for Bendix. They had been a competitor for some four years and achieved annual sales of over $10 million. They had a good computer already in the market place and several others in developemnt.

Yet, when all of the facts were in, we were forced to conclude that they had no alternative but to withdraw from the computer industry. Our 1960 reasoning remains valid today.

IBM and its nearest competitor can be expected to continue to hold more than 70% of the market.

IBM has established a pattern of rental that requires the infusion of massive amounts of capital and substantial losses before break-even.

IBM sets de facto standards for the industry—unilaterally and secretly.

Participation in the computer market requires major expenditures for hardware and software development and the creation of a large, nationwide, sales and service organization.

In our report to the client, we concluded that "—in addition to IBM [in light of their control of 70% of the market] there is room in the market for only two or three other companies on a profitable basis. Currently there are at least sixteen companies almost all of which are knowledgeable, well financed firms with an avowed purpose of making a permanent place in the computer business." We went on to say, "In our opinion, all but three or four will fail to do so, but the economic pressures and profitless sales volume that will result from their attempts will be very costly to all concerned.

In two to five years, after the present competitive situation has shaken down, at least two and maybe more, in addition to IBM, will find a position in the field. The chances are that they will come from the top of the above list.

It is not easy to advise a client to withdraw from a market and forego what might later prove to be a substantial profit opportunity. Our conclusion as to IBM's monopoly power was questioned by many. Attachment 3 is a copy of an editorial carried in one of our industry's foremost trade publications shortly after our report was submitted to Bendix's top management. In essence, the writer concluded that free enterprise was alive and well and that innovation and superior price/product performance would tell. Of the authors *9 examples*, *6* have been forced to withdraw from the market. Perhaps of more importance, of the 16 companies that we had identified as serious entrants into the computer market in the late 1950's, ten (asterisked in the preceding list) have since failed or withdrawn from the market, and of those remaining, none has achieved more than a 10% share of the market.

It took almost two years and a total investment in excess of $40 million before Bendix was able to extricate itself from the industry. They were lucky—they sold the division to Control Data Corporation for $10 million in CDC stock (see Attachment 4, and in turn sold their stock of CDC's all time high. When it was all said and done, Bendix proved to be one of the few "winners" in the computer industry.

Weakness of Competitors An Indicia Of Monopoly Power

Judge Sherman A. Christensen, in rendering his decision in the *Telex vs. IBM* case [72–C–18, United States District Court for the Northern District of Oklahoma—Sept. 17, 1973] said:

"The strength of competitors is relevant to an assessment of market power. Monopoly power presupposes the power to control what happens in a relevant market. Ease of entry may be an indication of lack of market power on the part of an alleged monopolist. Difficulty in entering, weakness of competing companies and dependence of competitors upon dominant forces in the market are among indicia of market control on the part of an alleged monopolist. . . . If the percentage of a relevant market controlled by an alleged monopolist is high an inference of market power may be drawn. Where its control is moderate no inference of market control may be permissible. In case of a medium range, it may be impossible to infer or to rule out monopoly so that factors other than market percentage must be looked to primarily. Where there is direct credible evidence of market domination or predatory practices which are productive of control in a particular relevant market, inferences need not be depended upon but this more direct evidence may be determinative. Other factors to be considered are any necessity on the part of an alleged monopolist to meet competition in technology and pricing, the equality of performance in the industry and its comparative youth, growth and dynamics or change."

Judge Christensen went on to say, "Claimed necessity of responding to competitive influences beyond the control of the alleged monopolist may be only its excuse for anticompetitive conduct for the purpose of maintaining or extending monopoly power or to surmount threatened competition, *and monopoly* is possible in a young, dynamic and complex industry, as well as in an old or static one, and *may be even more feasible* in special cases *through masking of selective market strategies in the overall technological developments.* Sophistication of users or competitors may discourage monopoly but equal or greater sophistication on the part of an alleged monoplist may be a counter-balancing factor, and industry dynamics may continue in evidence through technological momentum beyond the inception of monopoly." (Emphasis added)

Although many companies (less than two dozen by my count—more than 100 by IBM's count) have sought to carve out a profitable niche in the general purpose computer systems market, few have succeeded. One must ask, how is this possible? It is almost inconceivable that the vast majority of these companies were poorly managed, under-financed, or incapable of satisfying a valid customer need. Those who have sought to penetrate this market have lost in total literally billions of dollars of their shareholders' money—yet their corporate power and ability ranks them among America's most successful corporations—Ford, RCA, Litton, GE, Bendix, Philco, North American Aviation, and Xerox to name only a few—have become household words, yet none has been able to reach break-even in the computer business. One can only conclude that a formidable giant must guard the gate to the computer market place and to the land of profits.

Innovation

Fortunately, the attempts of other companies to enter the computer market did not represent a compete loss. The industry and our nation benefited greatly from these companies' transitory participation. In their efforts to penetrate the market, they became the principal sources of innovation during the 1950–1970 time-frame. Though the record shows that IBM has obtained more than 10,000 patents, a substantial majority of the improvements in computer performance have been first brought to the market by others. In almost every instance, IBM has lagged behind rather than led the technology in the market place. An indication of their failure to innovate, is vividly shown in Attachment 5 and 6. Attachment 5 was taken from the Minutes of the IBM Management Committee. Attachment 6 is the summary portion of an internal IBM appraisal of their products versus those of their competitors. Both documents were entered into evidence in the Telex vs. IBM case.

This is not to say that they have not been inventive—undoubtedly they rank among the top two or three companies in the world in research and development. However, they have seldom brought the fruits of their labors to the market place until forced to do so by competitive pressures.

For example, IBM points to the continuing improvement in the price/performance ratio of computers as an indicia of the competitiveness of the computer market. The facts, however, show that costs and prices have largely been lowered by conversion from vacuum tubes to solid state devices. The latter were based on research by Bell Laboratories. Similar situations may be noted in the use and application of virtual memory, time-sharing, remote terminals, and most other important advances in the state of the art.

The reason IBM invents—but doesn't innovate is obvious. If you rent your product, and recover your investment in X months, the bulk of the revenues derived beyond this point are profit. The longer the product can be kept in place, the more profitable it becomes. Under these circumstances the motivation is to maintain the status quo as long as possible—bringing a new product to market only when competitive pressures make it mandatory.

If innovation has not been the source of IBM's dominance of the computer industry, what has?

MONOPOLY POWER IN A HIGH TECHNOLOGY INDUSTRY

Judge Christensen answered this question in part when he said in his conclusions:

> C18 Correspondingly, the court concluded that . . . maintenance of IBM's monopoly power in the relevant product market for plug compatible peripheral products was not the result of IBM's superior skill, foresight, or industry and was not the result of superior products, business acumen or historic accident. To an extent, it was its failure, as IBM itself recognized, to develop new technology and superior performing products as rapidly and effectively as it had hoped, and the capability of plug compatible manufacturers to keep abreast of, and in limited instances surpass, some of the technological developments and jeopardized its monopoly position in the relevant product market, and that motivated it to undertake predatory pricing and long term leasing to stem the growth of its plug compatible competitors.

Judge Christensen also noted:

> C15 From its found predominant market shares, the court infers and concludes that IBM had and exercised monopoly power in the relevant market and submarkets here defined. Circumstantial evidence apart from that relating to market share is indicative of IBM's market power in the relevant market and submarkets as they have been defined. Its own strategy, investigations, and planning were premised to an important degree upon the assumption that it had such power. The very predatory intent with which, as already has been found, its strategies were planned, as well as the nature and direction of its competitive responses, strongly suggest a consciousness of market power and a determination to utilize it to the extent that it was considered this could be done without a breach of its confidential plans or its becoming involved in legal difficulties. This is not to say that there was any ruthless or nakedly aggresive programs contemplated or carried out; anything that was done by way of strategy was sophisticated, refined, highly organized, and methodically processed and considered. But in this day and age such conduct is hardly less acceptable than the naked aggressions of yesterday's industrial powers if unlawfully directed against competition. The organized, selective, subtle and sophisticated approach, indeed, may pose more danger under modern conditions than instantly more obvious strategies.

IBM V.P. Confirms Judge Christensen's Findings

Although sequestered in the *Telex vs. IBM* case, a document was entered into the public record in the *U.S. vs. IBM* case that bears upon IBM's use of a combination of sophisticated and subtle techniques in its programs to maintain absolute market control. This memo, written by IBM's Director of Business Practices, and discovered in files of IBMs Director of Marketing, is shown as Attachment 7 and a facsimile is reproduced below:

THOUGHTS FOR CONSIDERATION

The liability of IBMs risk lease is dependent on price leadership and price control.

By means of price leadership, IBM has established the value of data processing usage.

IBM then maintains or controls that value by various means: (timing of new technology insertion; functional pricing; coordinated management of delivery; support services and inventory; refusal to market surplus used equipment; refusal to discount for age or for quantity; strategic location of function in boxes; "solution selling" rather than hardware selling; refusal to support subsequent use hardware, etc.

Unbundling has created a new threat to IBM's price control.

By eliminating fixed price solution selling of hardware eventually leading to increased price competition.

Functional pricing already under pressure because of OEM activity. Unbundling will increase that pressure.

Equalization of subsequent use adds value to existing third party inventories.

Legal problems are emerging as a result of certain practices which are key underpinnings to price control.

Refusal to market used machines and parts.

Refusal to sell bills of material.

Maintenance parts prices.

The key underpinnings to our control of price are interrelated and interdependent. One cannot be changed without impacting others.

These interrelationships are not well or widely understood by IBM Management. Our price control has been sufficiently absolute to render unnecessary direct management involvement in the means, [the next five or so lines were deleted from document].

The D.J. [Department of Justice] Complaint specifically covers varying profit margins and an intensive investigation of this issue would reveal the extent of our price control and its supporting practices. Such a revelation would not be helpful to our monopoly defense.

If IBM's price control is seriously threatened, either from the market or (because of unbundling) or from legal exposure (because of the supporting practices) or from the D.J. (because of demands for remedy) it is necessary that IBM Management fully understand its import in order to decide.

Negotiations' strategy with D.J. good vs. bad practices remedies good vs. bad structural remedies (or) decision to litigate.

Pricing Approach to New Systems.

Reduction of Legal Risk relating to practices.

Recommendation

Assemble a small, knowledgeable, secure group to think through these issues, particularly in their interrelationships—define the emerging environment and the various new forces which indicate significant new change—and map the rudimentary elements of strategy or alternative strategies for consideration by Management.

* * * * * * *

The effectiveness of these and other market control techniques has been obvious to those of us who have worked in the computer industry.

After more than two decades, IBM still holds almost 65% of the worldwide installed base of general purpose EDP systems. Domestically IBM's nearest competitor has a 9.4% share of the market and even this was achieved in part by acquiring GE's installed base. The third ranking competitor, Univac, with an 8% share acquired RCA's installed base when they closed the doors on their computer operation.

Tables 1 and 2 show the relative sizes of the principal domestic computer systems supplier. Although the revenues of the leaders are impressive by normal standards they are, within the context of the computer industry and IBM's dominance, relatively weak competitors with little influence on what happens. Like Chrysler and American Motors, they exist at the sufferance of the dominant force in the industry and provide the illusion of competition.

If IBM's control of this important industry is to be reduced, it is necessary to understand how it was obtained in the first place and how it is perpetuated today.

"Our Price Control Has Been Sufficiently Absolute . . ."

IBM policies and pricing in the area of computer systems is consistent with a long corporate history of exploitation of customers and the exclusion of competitors. In the 1920's the firm dominated the market for office tabulating equipment to much the same extent it now reigns over the computer industry. Then, as now, IBM wished to extract maximum profits from customers; the device it settled upon was to effectively charge high-demand users a higher price for their machinery than low-demand users by requiring all customers to purchase tabulating punch-cards from IBM itself—at inflated prices. In this fashion high-use buyers contributed proportionately more to IBM profits than customers with less need for the tabulating services. The courts eventually declared this practice illegal under Section 1 of the Sherman Antitrust Act.

As IBM emerged as the dominant supplier of computer equipment it again devised ingenious methods for profiting from and holding onto its monopoly. Though the technique of tying computing supplies to computer equipment was foreclosed by IBM's earlier confrontation with the Antitrust Division, the same ends were accomplished through slightly different means. The approach taken by management was to refuse to sell either computer mainframes or peripheral equipment outright, instead offering only month-to-month leases. Maintenance had to be purchased from IBM, with the minimum maintenance fee geared to a particular customer's usage.

U.S. MANUFACTURER MARKET SHARES—INSTALLED BASE (GENERAL PURPOSE EDP SYSTEMS, 1973)

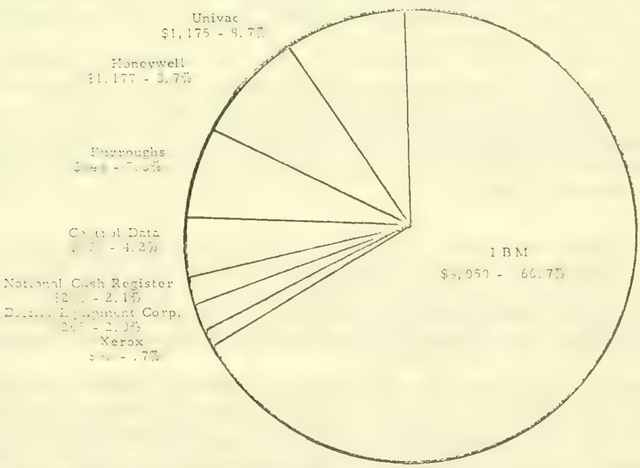
	Dec. 31, 1973, installed base					
	United States		Foreign		Worldwide	
	Value (millions)	Percent total	Value (millions)	Percent total	Value (millions)	Percent total
IBM	$17,406	63.8	$11,232	65.4	$28,638	64.4
PCM	1,325	4.9	295	1.7	1,620	3.6
Honeywell	2,578	9.4	2,036	11.9	4,614	10.4
Univac	2,205	8.1	1,378	8.0	3,583	8.1
Burroughs	1,421	5.2	823	4.8	2,244	5.1
CDC	973	3.6	740	4.3	1,713	3.9
NCR	737	2.7	468	2.7	1,205	2.7
DEC	134	.5	53	.3	187	.4
Xerox	390	1.4	81	.5	471	1.1
Others	132	.4	68	.4	200	.3
Total	27,301	100.0	17,174	100.0	44,475	100.0

Note: Totals may not add due to rounding.
Source: International Data Corp. (conference report Mar. 5, 1974, pp. 36.1–36.3).

1973 MARKET SHARES

ELECTRONIC DATA PROCESSING

MAJOR U.S. MANUFACTURERS



Note: T[illegible] may not add due to rounding, dollar figures are in millions.

Source: [illegible] & Poors except:
IBM - CIA adjustment of Martin Simpson, Standard & Poors, Lehman Bros. es[illegible]
Honeywell - 1973 Annual Report

Tying Arrangements and Discrimination

In two ways this lease-only, required-maintenance marketing structure enabled IBM to effectively charge higher prices for computing services to high-demand customers. First, customers with a greater need for computers would tend to want more peripheral equipment and, with a monopoly of both mainframes *and* peripherals, IBM could (and did) charge inflated peripheral prices. In this way the leasing of peripherals served to meter customer demand for data processing, and just as in the case of punch-cards and tabulating machinery 25 years earlier, higher profits were extracted from high-demand users.

The second method of discriminating in price between customers lay in terms of the maintenance contract required of all lessees. More intensive users had to pay "extra-shift differentials" in addition to the minimum maintenance fee on the pretext that extra use resulted in added wear and tear on the machines. In point of fact, this provision simply forced the customer who found computers most useful to contribute a disproportionate share of IBM's earnings. The 1952 government antitrust suit sought to end this practice.

The Justice Department signed a Consent Decree with IBM in 1956, supposedly curbing IBM's abuse of its market power; the lease-only element of its marketing policies was eliminated, however, maintenance continued to be tied.

As in 1932, Sherman-Clayton had served to pry loose 1 of the 10 fingers closed around the customer's thoat. The free enterprise system was somehow supposed to loosen the others. Once again, the tenacity and creativity of IBM's management prevailed. Additional strategies were developed and implemented in order to freeze out potential competition.

The most significant anti-competitive policies through the 1960's were the maintenance lock and "software bundling" (the provision of operating and applications software at no extra charge to lessees). Both practices tended to erect insurmountable barriers to new company entry.

The Cost of Competing Has Been Kept High

No new firm could be expected to absorb the enormous start-up costs of duplicating either the IBM software library or its nationwide consulting and maintenance network in order to provide services to the scattered IBM customers choosing to buy rather than lease. Therefore any new competition would have to come from a total systems company which would have to risk the massive capital outlay required to design, manufacture, market, maintain, and provide software for a new line of systems. The potential rewards tempted RCA, GE, Philco, Bendix and others; their attempts resulted in some of the more renowned financial fiascos in American corporate history.

Until the late 1960's IBM's competitive stance was basically passive; the barriers to entry erected by long-term strategies had been successful in protecting its monopoly, and the firm was rarely required to take visible offensive action against competitors. But after the introduction of IBM's "System/360," a crack in the IBM armor was opened by one of the very practices which had earlier enabled the company to price discriminate among customers—separate pricing of mainframes and peripherals.

Predatory Pricing

In 1967 the Telex Corporation and other small electronics manufacturers began producing peripheral equipment designed to replace IBM tape drives, disc drives, and printers. Their products simply plugged into the IBM mainframe—hence the terms "plug compatible manufacturers" or "PCM's"— and were technologically superior yet less expensive than the IBM equipment they replaced. By 1970, *business for PCM's was booming.*

PCM's had captured roughly 10% of the plug-compatible market, leaving, of course, the remaining 90% to IBM. The IBM response was quick. A series of price cuts was initiated in 1970 which, according to internal IBM documents subpoenaed by Telex in its successful antitrust suit against IBM, were calculated to kill off the plug compatible competition. These were followed in 1971 and 1972 with long-term leasing plans (prohibited for 10 years by the 1956 Decree) designed to further erode the viability of the plug-compatible competitors. To offset planned revenue decreases in the peripherals area, mainframe prices were raised to maintain IBM's average profit at 32%. (See Attachments 9, 10, 11.)

Judge Sherman Christensen in his September 1973 decision in *Telex v. IBM* characterized IBM tactics as ". . . unlawful predatory conduct . . . intended to . . . maintain its monopoly position." The effect on the PCM's was devastating. Telex, for example, lost over half its sales from 1971 to 1972, and has yet to operate profitably since the IBM attacks.

The long IBM history of employing marketing strategies which exclude competitors with a view towards maintaining its monopoly power and profits is a textbook case of the abuses the authors of the antitrust statutes intended to prevent. When unchecked, IBM complacently reaped the fruits of monopoly ; when challenged, it responded with vigor to bring competitors—no matter how small—to financial ruin.

Traditional antitrust enforcement has focused largely on eliminating blatantly illegal practices such as collusion in restraint of trade, reciprocity, below cost selling, price fixing, and other such obviously unethical practices.

Perhaps it has been the failure to understand that the modern-day monopolist employs a variety of far more subtle techniques to maintain his monopoly power, that has caused the Department of Justice to miss the target on two prior occasions. Examples of some of the more subtle techniques now in use are provided below.

Computer Systems and Black Boxes

As Mr. Faw has so helpfully pointed out in his "Thoughts for Consideration," ". . . solution selling rather than hardware selling . . ." is a key underpinning of IBM's monopoly power.

At the very beginning of the design cycle, the architecture of an IBM system, including the interconnection and interactions between each of its separate functional parts, is structured to achieve efficient data processing and to lock the customer into IBM products and services.

This technique is employed in the design of the logical, mechanical, and electrical interfaces between the central processing unit (mainframe) and the subsystems such as disc drives, tape drives, memories, and printers. It is also used in the design of the software that operate the system. Several examples serve to illustrate the interaction between architecture and monopoly power.

Hardware Interfaces

With the introduction of the IBM 370 family of computers, IBM standardized—internally—on the interfaces between its central processing units and its peripheral devices. This move briefly increased the computer user's flexibility by allowing him to replace various devices as his needs changed.

In 1969, however, IBM realized that many customers were interconnecting peripheral devices produced by other suppliers—devices that were superior in performance and/or lower in price than the IBM equivalent—and took steps to remedy the situation. As one of several strategies aimed at stemming the competitive tide, IBM moved the electronic controller out of the peripheral device and into the computer mainframe. This forced competition to redesign its products and also restricted their opportunities to innovate in the electro-mechanical design area.

Because IBM hardware interfaces are kept secret until first product shipment, a user or a competitor wishing to interconnect must obtain the new product, reverse engineer the interface, and then design their device so that it works properly with the host IBM computer, obviously losing valuable time. It is this time that IBM's marketing force uses to sign up customers on one- or two-year contracts. When the competitor finally gets to the market, he finds that it is foreclosed.

If GE generated electric power *and* made electric appliances, an analogous situation would exist. By changing voltage and frequency unilaterally while informing no one but their own appliance designers, they could quickly capture 100% of the appliance market. Similarly, the recent Bell & Howell vs. Kodak case hinged on Eastman's use of the camera-film "interface" to obsolete competitive products and bring new systems into the market while foreclosing competitive response.

In this instance, in order to settle a private antitrust suit, Kodak agreed to disclose, 18 months before the first shipment, the specifications of any new film product (a market in which Kodak is alleged to possess monopoly power) to qualified camera manufacturers who request the information. A similar provision in the computer industry would be one significant step in reducing IBM's monopoly power.

Software

Software (the instructions that tell the computer what to do) has been used by IBM as a market control technique at several different levels.

An article from this month's *Datamation* magazine, (shown as Attachment 8), "IBM's Operating System Monopoly," sets forth the software that runs the computer is also used to further lock out competition. By including software

in the price of the system, competitive offerings are foreclosed. Moreover, by bundling the operating system with the central processing unit (CPU), IBM maintains absolute control over the useful life of the software and the system.

This control was recently used to "disconnect" competitive terminals from IBM systems. Terminals generally interconnect with a computer system over telephone wires—a standard interface available to all. Thus independent terminal manufacturers were permitted entry into this market. Soon a variety of superior price/performance products became available. When faced with the growing success of the independent terminal manufacturers, IBM simply announced that they would no longer maintain the software necessary to allow non-IBM terminals to interact with IBM computers. The mere announcement of this move severely impacted the sales, profits, and access to capital of the targeted competitors.

Media Standards

During the early transition from TAB equipment to computers, IBM fought competition by pointing to the investment represented by the data already in the customer's files in the form of punched cards; moving up to a compatible IBM computer, the customer would avoid the otherwise "horrendous conversion costs and the other problems" that would probably be encountered if a competitive machine were selected. As a result, IBM's conversion of its customer base from TAB to computer was almost total.

The Department of Justice, in filing suit against IBM on antitrust grounds in 1952, recognized that IBM's absolute control over the production of 80-column punch cards and their mandatory use on IBM's equipment, effectively tied the two products and permitted excessive profits.

Seeking to remedy this situation, the 1956 Consent Decree required IBM to reduce its share of the 80-column punch card market to 50% over seven years. Shortly thereafter, IBM "discovered" magnetic as *the* media for computer data storage and shifted away from punch cards. Thus, in one simple, but bold stroke, IBM escaped the thrust of many of the provisions of the consent decree and retained their market power.

IBM's ability to unilaterally set de facto industry standards for the various media used to record computer data provides yet another form of market control. In March of 1973, for example, IBM announced three new media: the "diskette," the "Winchester" data module, and the Group Coded Recording system for high density tape. IBM has, as usual, kept the specifications of these products secret. As a result, no competitor can offer a compatible product until well after IBM ships theirs. In the meantime, the consumer is limited to a single source of supply—IBM.

To make matters even worse, IBM refuses to sell (at any price) the calibration tapes and discs needed to insure compatibility when the media is used on competitive machines.

As we recently testified before the House Commerce Committee during hearings on the International Voluntary Standards Cooperation Act (H.R. 7506), standards are employed in many industries as a market control technique, but in our industry the dominant company resists the development of standards because their employment would unlock a major element of their market control. (Additional information on this problem is contained in the statement submitted by the Computer Industry Association to the House Subcommittee on Interstate and Foreign Commerce on April 22, 1974.)

So far, we have looked at anti-competitive strategies dealing primarily with the design and production of the computer system itself. Other, even more subtle, strategies depend upon *when* IBM does things and on *what* they tell their customers.

Timing of New Technology Insertion

As noted earlier, IBM's Director of Marketing Practices characterized the "timing of new technology insertion" as one of the key factors underlying the company's control over the value and cost of data processing.

As the dominant force in the industry, IBM carefully controls the level of technology available to the user. Their motivation is obvious—nothing can be allowed to prematurely obsolete the equipment IBM has out on lease.

IBM's risk-lease strategy requires that every new product or concept be subjected to careful analysis by one or more top management task forces in order to determine what, if any, adverse impact it might have on the installed rental base. If the otherwise obsolete product or technology is locked in place by soft-

ware or long term leases, the newer technology is withheld from the market; if replacement by a competitive product is inevitable, the advanced technology is taken off the shelf and brought to market.

Because of its enormous prestige, image, and market share (to this day almost every computer, regardless of manufacturer is called an IBM machine—every data center, the IBM room), no innovator can successfully market a new concept in computer technology unless IBM supplies its "seal of approval" by announcing a similar product. Without IBM's "blessing" the product or concept is doomed to be a commercial failure, regardless of its intrinsic or economic merit.

On the one hand, this means that it is next to impossible for a competitor to gain commercial acceptance of an innovation ahead of IBM. Time sharing (the concurrent utilization of a single computer by multiple users) is an instructive case in point. General Electric was convinced that this concept was an important new tool which would allow more efficient utilization of the computer's capabilities. GE struggled for several years in an effort to gain market acceptance of the concept.

Sometime after GE had withdrawn from the computer market, IBM "introduced" this innovation and it was immediately and widely accepted.

On the other hand, IBM can, and does, use "artificial" innovations to stifle competitors. By moving an interface, shifting the location of a controller from peripheral to mainframe, changing a communications protocal, or some similar "improvement", IBM can effectively obsolete any competitive product it wishes.

This ability to introduce new products, media or approaches that completely change the rules of the game—without warning—is another element of IBM's monopoly power. In this way, IBM is able to keep all of its competitors off balance; force them to spend excessive amounts of development dollars to "catch up", and squeeze them into a position where the competitor must recover his investment *and* his profit (if any) in three or four years while IBM can recover its in five.

No Trespassing

To a layman this much market control on IBM's part may well sound inconceivable. However, the well cultivated IBM image coupled with the lack of sophistication on the part of the consumer (again, a fact of life in our industry that has been a carefully nurtured by-product of IBM's dominance) makes it not only conceivable but nearly insurmountable.

This is not to say that IBM is able to suppress each and every technological innovation until it suits their profit objectives. An innovation that is transparent to the system and to user, i.e. that does not affect the architecture, function, or performance of the data processing system may be freely brought to market by a competitor. However, as noted earlier, it will achieve only limited commercial success without IBM's stamp of approval.

Many of the advances in our industry have been made by the smaller competitor who submitted a new, lower cost component or subsystem for an older design—for example substituting semiconductors for core memories or providing off-line capabilities in a printer controller so that it does not use CPU time.

Atlhough I did say that such innovations can be freely brought to market—I didn't say that IBM would allow them to be commercially successful.

"We Can't Guarantee the Performance of . . ."

When a change in standards, hardware or software interfaces, prices, or the timing of new technology insertion fails to keep one or more competitors in their proper place (small and weak), IBM has two additional trump cards to play.

The first involves notifying the customer that IBM cannot, or will not, provide field engineering support or maintenance of the computer so long as a competitive device is attached to the system. This strategy has been used extensively, and I might say very effectively, against the vendors of add-on memory subsystems. ITEL was forced to fight IBM in the courts, both in the U.S. and in Europe, in order to protect its customers from IBM's unilateral refusal to maintain their computers when memory other than IBM's had been added. In one instance, after ruling in ITEL's favor, a West German judge determined that IBM's arbitrary and capricious use of its monopoly power warranted forwarding the complete trial record to the government anti-cartel agency.

The "refusal to maintain" strategy effectively suppressed competition for several years. In order to survive, IBM's competitors were forced to seek relief in the courts. They eventually won injunctive relief, but by then, most of the damage had been done.

Their sales had been slowed, their ability to raise capital impaired by their future uncertainty, and their customers and potential customers had been warned! The warning was simple—but painfully clear. Attach a foreign (non-IBM) device to your computer and we (IBM) may be "unable or unwilling" to maintain your computer—and that would shut you and your company down, wouldn't it?

The "refusal to maintain" strategy lacks credibility in those cases where the competitive device is not physically integrated with the host computer—a computer terminal for example. IBM has recently begun informing customers that "IBM cannot/will not guarantee the performance of the system" if non-IBM devices are used in conjunction with it. A recent, and rather blatant, example of this ploy was in California's Teale Data Center Procurement where IBM made this caveat a part of its proposal.

For a number of reasons (many of which are included in a recently filed suit against the State of California and IBM), IBM had the Teale Data Center procurement locked up from the very beginning. From this position of strength they were in turn able to lock out competitive subsystems suppliers.

The Anti-Competitive Arsenal

I have discussed a number of the strategies employed, singly and in combination, by IBM to maintain its market control and to suppress competition. Unfortunately, time and space limitations prohibit detailing the literally dozens of oher anti-competitive strategies that IBM employs. This does not imply that the latter are any less effective than those discussed above. Many of them are classic monopoly tactics including;

the use of long term leases with punitive cancellation penalties to foreclose competition.

the lowering of prices on products where they face competition coupled with compensating price increases on products where competition is not a factor.

the announcement of "phantom" products to block legitimate competitive offerings.

refusals to deal—for example, IBM will not sell components or subassemblies to other manufacturers at any price.

the intentional withholding of planned product improvements—for later introduction as "mid-life" kickers—all calculated to obsolete competitive products without impacting IBM's own inventory.

and reciprocity.

Virtually all of the strategies I have mentioned are encompassed in the fifteen private antitrust suits and the Federal antitrust action now pending against IBM. Attachment 12 includes a number of IBM documents taken from the public record in the Telex and Greyhound vs. IBM cases. These documents highlight some of the attitudes and decisions of IBM's top management committees.

After reading these, and other IBM documents now in the public record, one cannot avoid believing that Judge Christensen's findings and Mr. Faw's memo come much closer to the truth as to the extent of IBM's monopoly power than do the protestations of their attorneys. The latter contend that IBM is besieged on all sides by more than one thousand able competitors and is watching its market share decline from its already paltry 38%. One may well ask, if this contention is true, how is it that not one single entrant into this market in the past decade has achieved revenues that even approach one per cent of IBM's.

Is there any doubt as to why the members of our industry petition the courts and the Congress for relief?

HOW HAS THE CONSUMER FAIRED?

The fundamental intent of our nation's antitrust laws is to protect consumers not competitors. One may well ask, how has the user of computers and of data processing services faired during these past two decades of IBM monopoly control?

Locked in from the Beginning

As we noted earlier, IBM's key underlying competitive strategy has been to maintain maximum product differentiation, to avoid any meaningful industry standardization, and to provide upward mobility within its own line. Whether the early computer user started with IBM punch card accounting machines, or by having his data processing work done by the IBM Service Bureau (SBC), or

by renting his own computer, he soon found that conversion to a competitive system was virtually impossible. IBM's software is so intertwined with its operating and data storage systems that they cannot easily be separated because much of the programming would have to be redone at substantial cost. One user, testifying in the Telex vs. IBM case indicated that the problem of converting from an IBM system to a competitive system was so complex—and therefore so risky, he would not change vendors, despite the price/performance advantages that might be available.

A variety of strategies have been employed by new entrants to this market in their efforts to penetrate this barrier. The limited penetration they have achieved, and their relatively stable market shares over a 20-year span of dynamic market growth, would indicate that no strategy has succeeded.

Conversion costs and problems are part of the answer. IBM's image is another.

IBM!

During the course of my research for Bendix in 1957 and later in 1960, I had occasion to question many data processing managers and corporate executives about their reasons for selecting IBM equipment. Almost without exception their responses included:

IBM's equipment is second best in terms of price/performance.
IBM's service and support is second to none.
IBM already has the software I need.
My management thinks IBM is the better choice.

and besides,

If I buy a non-IBM system and something goes wrong, I'd be in trouble—if I buy IBM and something goes wrong, It's "an act of God!"

In this way, the level and quality of IBM's service and support *and* their carefully nurtured image, have kept the user reasonably well satisfied *and passive.*

Of course, few users had any idea of the costs and penalties, the withheld technology, and the behind-the-scenes practices being employed to keep competitors in line. The user had no idea what his world might be like if there were in fact true competition for his business. On occasion, he heard rumblings from frustrated and disgruntled IBM competitors, but IBM assured him that all was indeed well with the world.

Only in recent months, as a result of the U.S. vs. IBM, CDC vs. IBM, Greyhound vs. IBM, Telex vs. IBM and other antitrust suits, has the computer user begun to see the scope of IBM's control over his destiny. Even so, he remains largely passive. Perhaps because "this is the way its always been."

It May Also Be Fear

On a few occasions, data processing personnel and computer users have sought to step out from beneath the IBM umbrella. Their attempts to do so have often been met with speedy and sometimes overwhelming retribution. The data processing manager who steps out of line may suddenly find that his boss has been advised by an IBM salesman that "old Joe's out of touch with all the new technology." Or perhaps, as in several states, including Delaware and Nebraska, copies of letters disparaging the competence of the troublesome individual in the State's DP Selection Office are circulated to members of the legislature. Usually, such tactics aren't required. The data processing professional experienced in working with IBM systems knows that his most profitable career path lies in working with IBM systems—and he knows also that his next employer will, in all likelihood, ask IBM to pass upon his qualifications.

In this environment, few if any, members of the data processing industry are willing to speak out if it might later lead to problems with IBM. Witnesses who had agreed to testify for the plaintiff in Telex vs. IBM suddenly changed their minds. Last month an executive in charge of data processing of a major corporation had agreed to participate in a panel discussion before the New York Society of Security Analysts on "Restructuring the Computer Industry, Its Impact on Producers, Users and Investors." After receiving one phone call, his Chairman of the Board in turn called him and instructed him to cancel. These are not isolated examples.

IBM's control over the destiny of the computer and data processing industry is all-pervasive. Its power is undisputed. Those who work in industry have accepted this as a fundamental fact and have therefore learned to live with it.

THE PRICE OF CONTINUING MONOPOLY

In my opening remarks, I noted that the IBM Corporation has an awesome amount of economic, market and political power. I hope that I have been able to provide some insights into the extent of this power and its sources.

This one company can, if it so chooses, bring the economy of America to a grinding halt. Its self-perpetuating management answers to no one. The controlling shareholders care very little about what management does, or how they do it, so long as they keep piling up profits. Their employees are well taken care of and happy—their customers are passive—their competitors are impotent. *There are no checks and balances.*

Our European and Asiatic trading partners recognize the import of what I have reported here. They too fear total IBM dominance. At present, they are striving to stem the tide by pouring massive subsidies into their indigenous computer industry. So far, it has done little to shake IBM's hold on their own computer industries. Gradually, non-tariff trade barriers (NTTB's) are being erected in the hope that the American stranglehold of their industry will be broken. To date, these NTTB's have impacted the exports of U.S. based manufacturers, however, it has had little effect on IBM.

But what about us?

THE UNITED STATES VS. IBM

Our government moved to remedy this problem on the last day of the Johnson administration by bringing suit against IBM. Almost six years have elapsed.

During this period, IBM and its attorneys have used every conceivable tactic to delay its coming to trial. They have been chastised by two Federal judges for destroying the index to evidentiary material prepared by Control Data; they have been held in contempt of court for refusing to turn over documents; and they have created diversion after diversion. Two appeals to the Supreme Court have been denied and now, three months before the trial is to start, they are laying the ground work for another appeal to the Supreme Court. Each day's delay is worth more than $4 million in net-after-tax profits to IBM, so why not drag it out?

Clearly, they have the ability to do so. The defendant's legal staff outnumbers that of the Department of Justice by more than ten to one. Obviously in a case involving depositions of more than 1,000 companies, over 500 witnesses, and some one million five hundred thousand pages of evidentiary material, this imbalance gives IBM a distinct advantage over the Antitrust Division of the Department of Justice.

In the meantime, the capital markets have turned their backs on all but a few industry participants. Many have concluded that IBM's market power will not be curbed and that its control over competitors will remain unchecked. The refusal to invest in IBM competitors makes predictions of their demise a self-fulfilling prophecy.

Even now, IBM is putting the finishing touches on its 1977 product line. If the internal documents now in the public record are at all indicative, the strategies are already in place to insure a continuation of IBM's market power and control for many years to come. Relief from the IBM monopoly will not come from the application of backward looking antitrust concepts and simplistic relief plans.

Imaginative solutions must be developed—solutions that bring the benefits of free and open competition to the computer market place and that serve the best interests of the industry, the investment community, and the public.

We do not wish to see IBM punished. They have made invaluable contributions to our industry and to our nation. We do not wish to see them regulated like AT&T for this would stifle their creativity and skill.

However, we believe that it is essential that their unilateral control over the computer and data processing industry be ended—completely.

Should the Congress fail to deal effectively with monopolization of the computer industry, the nation will be exposed to potentially massive economic harm resulting from unfettered abuse of the dominant firm's market power. IBM has already shown itself perfectly willing to sacrifice near-term profits to bring competitors to financial ruin, thus insuring its monopolistic prices and profits over the long run. Eventually, potential challengers will realize the sure folly of attempting to introduce even technologically superior, lower-cost products in an environment of predatory IBM responses. When potential competition is

exhausted—when even the RCA's and GE's fear to tread upon IBM territory—the only remaining check upon IBM behavior will have disappeared.

The threat of eroding market shares serves as a powerful force, spurring firms in other industries to make technological improvements, keep prices at a reasonable level, and generally respond to customer needs. For IBM, that threat will no longer be real, as potential competitors will fear the financial consequences of challenging IBM dominance. America will then be faced with an unthreatened one-firm computer industry as complacent, as un-innovative and wasteful as the "legally monopolized" telephone industry has already been allowed to become.

Thank you.

Attachments: (18).

Attachment No. 1

COMPUTER INDUSTRY ASSOCIATION

MEMBERSHIP ROSTER, JULY 1, 1974

Advanced Memory Systems, Inc.
Applied Data Research, Inc.
Amdahl Corporation
Applied Magnetics Corp.
California Computer Products, Inc.
Cambridge Memories, Inc.
Centronics Data Computer Corp.
Cincom Systems, Inc.
Computer Machinery Corp.
Computer Optics, Inc.
Cullinane Corp.
Datapoint Corp.
Data Printer Corp.
Dataproducts Corp.
Delta Data Systems Corp.
Digital Scientific Corp.
Electronic Memories and Magnetics
Foresight Systems, Inc.
General Automation, Inc.
Incoterm Corporation
Inforex, Inc.
Informatics, Inc.
Information Magnetics Corp.
ITEL Corporation
Levin Computer Co.
Logicon Corporation
Memory Technology Inc.
Microdata Corp.
Mohawk Data Sciences
MRI Systems Corp.
Odec Computer Systems, Inc.
Palyn Associates, Inc.
Pertec Corporation
Randolph Computer,
Sanders Data Systems Inc.
Storage Technology Corp.
Tally Corporation.
Telex Corporation.
Terminal Data Corp.
Xytex Corporation.

Attachment No. 2

	SR		IBM		Honeywell		RCA		NCR		Burr		GE		CDC		Philco	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
1955(W)	31,920	38.10	47,372	56.55			4,200	5.01	280	0.33								
1955(D)	31,920	38.48	46,553	56.12			4,200	5.06	280	.34								
1956(W)	50,190	18.38	206,569	75.66			4,200	1.54	280	.10	11,782	4.32						
1956(D)	50,190	18.64	202,852	75.32			4,200	1.56	280	.10	11,782	4.38						
1957(W)	81,270	15.94	402,872	79.01	1,680	0.33	4,200	.82	280	.05	19,580	3.84						
1957(D)	81,270	16.31	391,238	78.54	1,680	.34	4,200	.84	280	.06	19,470	3.91						
1958(W)	115,710	15.93	566,001	77.92	6,720	.93	12,600	1.73	280	.04	23,582	3.25	1,484	0.20				
1958(D)	115,710	16.34	548,035	77.40	6,720	.95	12,600	1.78	280	.04	23,205	3.28	1,484	.21				
1959(W)	178,836	17.28	778,253	75.18	11,760	1.14	13,860	1.34	1,176	.11	42,437	4.10	8,904	.86				
1959(D)	178,836	17.75	750,997	74.54	11,760	1.17	13,860	1.38	1,176	.12	42,033	4.17	8,904	.88				
1960(W)	220,332	15.65	1,023,224	72.66	11,760	.84	32,970	2.34	4,704	.33	47,258	3.36	38,328	2.72	12,852	0.91	16,800	1.91
1960(D)	220,332	16.24	971,804	71.62	11,760	.87	32,970	2.43	5,880	.43	46,090	3.40	38,328	2.82	12,852	0.95	16,800	1.24
1961(W)	303,156	14.44	1,490,818	71.00	39,732	1.89	60,690	2.89	16,716	.80	53,835	2.56	67,209	3.20	42,756	2.04	25,200	1.20
1961(D)	303,156	15.49	1,355,232	69.25	39,732	2.03	58,170	2.97	14,530	.74	51,353	2.62	66,915	3.42	42,756	2.18	25,200	1.29
1962(W)	319,662	11.34	2,004,576	71.09	62,706	2.22	107,520	3.81	55,226	1.96	59,781	2.12	97,701	3.46	80,808	2.87	31,920	1.13
1962(D)	319,662	12.35	1,810,110	69.91	58,380	2.25	89,376	3.45	47,863	1.85	57,354	2.22	95,349	3.68	80,808	3.12	30,240	1.17
1963(W)	397,509	10.13	2,764,129	70.46	71,077	1.81	167,084	4.26	108,648	2.77	97,451	2.48	129,507	3.30	151,851	3.87	35,616	.91
1963(D)	397,509	11.15	2,489,221	69.84	64,701	1.84	123,981	3.48	94,817	2.66	90,794	2.55	125,979	3.53	142,275	3.99	33,936	.95
1964(W)	570,759	10.68	3,650,610	68.46	129,810	2.43	204,937	3.83	159,638	2.99	166,039	3.11	169,538	3.17	243,740	4.56	41,664	.78
1964(D)	570,759	11.79	3,306,253	68.30	118,915	2.46	147,267	3.04	133,919	2.77	147,737	3.05	160,823	3.32	214,970	4.44	39,984	.83
1965(W)	728,923	10.79	4,398,308	65.10	255,444	3.78	236,204	3.50	219,122	3.24	253,541	3.75	228,588	3.38	392,171	5.80	44,352	.66
1965(D)	728,923	12.08	3,938,446	65.28	231,874	3.84	173,122	2.87	173,083	2.87	217,018	3.60	201,587	3.34	328,318	5.44	40,488	.67
1966(W)	1,006,114	10.10	6,504,163	65.30	517,084	5.19	338,217	3.40	294,745	2.96	321,807	3.23	372,592	3.74	565,291	5.68	39,816	.40
1966(D)	1,006,114	11.27	5,910,929	66.20	464,134	5.20	244,984	2.74	214,716	2.40	271,117	3.04	311,518	3.49	468,781	5.25	35,952	.40
1967(W)	1,246,925	9.40	8,891,566	66.98	619,538	4.67	541,338	4.08	432,466	3.26	387,943	2.92	431,557	3.25	697,116	5.25	25,704	.19
1967(D)	1,246,925	10.59	8,014,659	68.06	555,936	4.72	381,653	3.24	298,094	2.53	346,223	2.94	355,925	3.02	554,053	4.71	21,840	.19

Attachment No. 3

DATAMATION—THE AUTOMATIC HANDLING OF INFORMATION

THE WEED OUT!

Still prognosticating a dim future for the staying power of computer manufacturers, a generous number of market analysts have gathered and garnished their statistics with perfectly reasonable logic.

Their basic contention: although the market for hardware will continue to prosper, it is clearly impossible for the present number of computer manufacturers (a) to survive the substantial investment required for advanced technology, particularly where there is no strong alternative market to absorb heavy annual losses (i.e., t.v. sets or electric razors); (b) to maintain satisfactory field support and software backup; (c) to mass produce medium and large scale systems, and finally (d) to compete with a large flock of comparable firms, all offering basically the same equipment for "a narrow, vertical market."

Their conclusion: "the weed out" will surely take place within a handful of years with three or four firms dominating the field and the remainder (if they insist on remaining) accepting a minute fraction of the market.

In support of their forecasts, market analysts have been confronted with one irksome problem, namely, *all visible evidence of late, has indicated they are dead wrong in both contention and conclusion.*

Despite the fact that a number of forecasts have pointed to small companies as the first to expire, it is precisely in this area where some of the real strengths of the industry have appeared. Not only have these "weenies" persisted in selling their machines, but they continue to announce new hardware of sizeable proportions.

Perhaps the best example is Control Data Corp. with its 160A, 1604, soon-to-be-announced 924 and Stretch-class 660. Packard Bell's Computer is another case in point where rumor of corporate lack of optimism in its computer division will find little support when PB announces its 350 late this Fall. Computer Control Corp.'s forthcoming DDP and El-tronics' ALWAC IV, a solid state entry to be ready next year, are further indications that the staying power of the small company is not to be underrated.

Having recently completed its 100th 7090 installation and with a flock of small to medium-sized contenders rolling off its production lines, there is little doubt that IBM will continue as the giant in the computer industry. But companies such as RemRand, well-known for their ability to turn an advantage into a loss, have shown promising signs of twisting the bit in the opposite direction. Surprises are also forthcoming from RCA with research in high speed circuitry through diode memory.

As for others: Burroughs is very much in the solid state field with the 5000, 270 and forthcoming announcement of the 260. Philco has stuck neatly to its 2000 series improving speeds with the 212. Advances in high speed tape units and mass storage devices are also under development by Philco.

Sales of the Honeywell 400 have been excellent and FACT although embarrassingly late, reportedly is now ready to fly on the 800. Some technological rabbits may also be pulled out of General Electric's new Sunnyvale hat.

In general, the most pessimistic news for computing market analysts is the obvious fact that within the last three years, no one has left the field. There are of course, some trends which have influenced the health of the industry; namely, a tempering of the early fever of the sales pitch which could easily have driven a company or two into trauma and ultimately out of the computing business. Also, there is a muturing realization of the need for long term investment coupled to a gradual shift in the purchase vs. rental balance providing smaller firms with a more encouraging, earlier dollar return. Finally, the field itself has expanded from what may have been a narrow, vertical base of a decade ago, to a rapidly growing tree sprouting numerous horizontal branches such as process control, real time control, and many new areas of general purpose application.

It would seem therefore, that "the weed out" is hardly a frightening prospect except that as the prophecies do not bear fruit, the job security of the prophesiers may be inversely effected.

Attachment No. 4

BENDIX GIVES UP ON COMPUTERS—SELLING ITS COMPUTER DIVISION TO CONTROL DATA CORP. SALE PRICE, ACCORDING TO A PRELIMINARY AGREEMENT, IS UNDER $10-MILLION TO BE PAID IN CASH AND STOCK

Whenever a contender in the electronic computer business cashes in his chips—as Bendix Corp. announced it was doing this week by selling the assets and business of its Computer Div. to Control Data Corp.—the poker faces of the remaining contenders stiffen. They know that with another man dropping out, the game may well get harder rather than easier. The game of Electronic Data Processing—or EDP—is played with megabucks, and it's almost as fast as three-card Monte.

THE LOSS

Most people in the industry believe that it cost Bendix as much as $30-million to try its luck. But Bendix Pres. Malcolm P. Ferguson says that a $40-million investment figure that has been circulating through the industry is extraordinarily high. At this time, he refuses to say how much Bendix did invest in computers. According to a preliminary agreement between Control Data Corp. and Bendix, the purchase price for Bendix's computer division is under $10-million, to be paid in stock and cash over a period of time.

If the loss is in that magnitude, it indicates that getting out of the game is more costly than ever. Royal McBee Corp. and Underwood Corp., both of which backed away from the table when the stakes started to skyrocket, figure they lost about $8-million and $12-million, respectively.

STUBBORN OPTIMISM

Bendix's departure also has started speculation among the kibitzers that this may be the beginning of a shakeout in the industry that will result in a sudden rush of mergers or dropouts. But, even though few companies in the industry have seen black ink on their books yet, a major shake-out or merger trend is unlikely at this time. The remaining contenders in the business-scientific field—International Business Machines; Univac Div. of Sperry Rand; Control Data Corp.; General Electric Co.; Philco Corp., a subsidiary of Ford Motor Co.; RCA; National Cash Register Co.; Minneapolis-Honeywell Regulator Co.; Burroughs Corp.; and Monroe Calculating Machine Co., a subsidiary of Litton Industries—all feel stubbornly certain that it's in the cards that they'll be among the big winners.

Not a few of these companies have suffered shortages in working capital because of the delayed return on leased equipment. But most console themselves with the thought that they would be in the black if equipment out on rental were considered as sold. In other words, if they had sold their computers instead of renting them, they would be ahead of the game. Even if such rationalizations are not the way the game is played according to the rule book, it helps morale.

EARLY STARTER

Although Bendix was one of the early computer manufacturers—it delivered its first G–15 computer to an oil company in 1955—it never "had big ambitions in business data processing," according to Ferguson. The G–15 computer is a relatively small, electron-tube computer used primarily for engineering and scientific calculations. About 270 of them have been sold since 1955.

In 1959, the company decided to build a transistorized computer slightly larger than the G–15. It grew into a much larger system—the G–20—a large-scale data processor that can be used for both business and engineering. However, because of its relatively limited marketing program, Bendix was unable to develop as complete a line of software—programming packages for users—as its competitors, and the G–20 sold slowly.

BEGINNING OF THE END

When Bendix failed to replace the G–15 with an equivalent transistorized computer, its market position plummeted.

Last year, Ferguson announced that Bendix was giving up all attempts to get into business data processing and would concentrate on engineering and scientific markets only.

NATURAL BUYER

When Bendix made the decision to withdraw, it didn't take long to find a buyer. There are good reasons why CDC wanted it. The Minneapolis company, famous for being the only other profitable operation in the computer business besides IBM—is strictly a computer specialist. And the Bendix line dovetails nicely with its own.

Started by a group of engineers from UNIVAC in 1957, CDC's first product was a large-scale solid-state computer, the 1604. This was delivered in 1959, and 43 of them are now in operation. Initially, the company's objective was to make a fine computer and sell it to customers—universities and research laboratories—who knew how to program it and would need a minimum of expensive programming and training aids.

Generally, CDC has used a highly accurate marketing technique. It claims it sells two out of every three customers to which it presents a systems proposal (average cost—$20,000 a pitch).

GOOD FIT

Bendix fits right into CDC's future plans. The older tube-model G–15 is slightly smaller than CDC's solid-state 160 computer. And since customers almost always move up when they replace a computer, CDC will have a fine basis for upgrading G–15 users to its own 160s. And the G–20—the big Bendix unit—fills a niche in Control Data's line of larger equipment, an extensive array that includes the largest and fastest computer systems now made in the U.S.

Attachment No. 5A

PLAINTIFF'S EXHIBIT 386–060

MANAGEMENT COMMITTEE MINUTES

Present: Mr. W. C. Hume, Mr. D. R. McKay.

I. Hume and McKay discussed their impressions of the BEMA Business Show in New York. Most major systems manufacturers did not demonstrate, the exception being CDC. A significant percentage of the exhibits involved copiers, printers, and terminals.

II. Chien, Gore, and Andres entered. Chien reviewed some recent work he has done on the NPII Model. While the original task was to cast light on the underlying causes of the 1970 poor performance, Chien believes that the work has long-term ramifications as well. The model assumes that NPII depends on four major factors—the economy, the product cycle, the announcement strategy, and new market environment. The model itself deals mainly with the first three factors, acknowledging that items such as unbundling are at this point highly judgmental. The unbundling influence, however, has been added to the conclusions. Historic: NPII has gone in cycles and although it can be broadly related to the PED index, it doesn't correlate on a year to year basis. Chien has concluded that historic differences from the PED index are tied to product cycle and notes the clear upturn at the time of first customer ship of the first, second, and third generation equipment. He theorizes that historically, we have clustered our first cutsomer shipments, giving us first an acceleration stage as new applications fill the quantum jump price/performance capability and then a deceleration stage as we and the customer get more efficient in operating the newer equipment. Chien's model indicates that we announced the 1401 a year too early and the /360 a year too late. He believes that we have not seen a comparable phenomena to 1970 in the past even though it was there because since 1958 there has never been a dovetailing of a poor economy coupled with a deceleration stage in the product line. He also concluded that product announcement and ship cycles have greater impact on NPII than does the economy although the two are obviously interactive.

Looking forward, he concludes that the NS announcement strategy, based on spaced announcements and first customer ship, will have the effect of slowing down the acceleration stage, generating worse than anticipated in NPII in 1971, '72, and '73 and with the availability of the complete product line in 1974 going well over normal expectations. Chien also concludes that there will be no overcapacity in the marketplace for some time but that the key to expansion is significantly increased by price/performance, i.e., supply creates its own demand. Since the NS is not as dramatic a step forward as the /360 was, Chien

concludes this will inhibit growth. If his theory is correct, the product cycle will take effect with first customer-ships in 1971. However, the spreading announcement strategy will hurt comparative immediate revenue, although tempering the cycle. Such a smoothing of growth, according to the model, can only be achieved by less than desired revenue growth over the next several years. Lastly, Chien is convinced that 1975 could be 1970 revisited, particularly if the economy is not healthy at the same time. The MC noted that NPII and profits, while related, are not at all the same.

The MC thought the work was very thought provoking and requested that they get together with Chien again off-line after he has gone over his 1974–76 time frame conclusions with Beitzel.

III. All left and Piore, Baskin, Shapiro, and Bertram entered to cover the Printing Strategy. Piore indicated that this is not a CTC-approved strategy because of a number of issues which the CTC expects to resolve in some 60 days. Piore indicated that the printing area has some of the characteristics of disks and tapes of three years ago. We are very strong in the marketplace and we are continuing to use old technologies. Both Piore and Bertram believe that the control unit for the printer will pose technical problems for competition, but they feel that plug-to-plug printers could arrive in the marketplace shortly. Competition has recently made three announcements. Telex has purchased $25 million worth of CTC printers and it is possible that they will offer a printer disk and tape package. If technology allows the introduction of a universal controller over the plan period, it would result in a clustered self-contained I/O subunit. Xerox has announced its intent to get into the computer printing business using a nonimpact printer. A. B. Dick has announced and demonstrated a non-impact printer using ink jet technology.

The MC reviewed a number of promising products in the planned program ranging from SPICA, a 15 character/second printer to ALTAIN, the new 1600 line/minute printer. All of these printers, however, are predicated on older technology. The only printer presently involved in advanced technology is the Jubilee which is a non-impact unit with an effective speed of some 3,000 lines per minute. This printer is being developed in San Jose and is presently scheduled for announcement in 1972. Piore believed there is less than a 10% chance that it will be available within a five year period. Bertram is somewhat more optimistic but even Baskin acknowledged that there are significant technical problems to be solved and insufficient resources devoted to the solutions.

The Science Advisory Board is meeting in Lexington next week to discuss the best method of getting the Copier technology into the printer line. In the ink jet area, all acknowledged we were well behind and in fact we've only recently started an audit to see whether we have basic license and patent problems.

At the low end, the MC noted that high maintenance charges combined with long life make it very difficult to develop printers at a satisfactory profit. Hume and McKay believe that the probable solution to this problem is planned price increase and noted that Opel is examining this alternative in conjunction with the KEEP Program.

Attachment No. 5B

PLAINTIFF'S EXHIBIT 384B–016

Present: Mr. R. H. Bullen, Mr. G. E. Jones, and Mr. M. B. Smith.

I. Jones reviewed the key points covered in the DPD State of the Union Measurement meeting as follows:

A. DPD feels undermanned in the sales area. Jones stated that Hubner felt the training of DP personnel in BOA was a first priority for any additional funding.

B. Product Marketing provides a heavy focus on product rather than on the market. Jones stated he was not in agreement with the relative priorities.

II. Anderson, Spatz, Piore, Hume, and Knaplund entered for an informational presentation on Integrated Circuits.

A. Spatz reviewed the historical background on circuits from tube to transistor to SLT to integrated circuit chip. He stated the motivation for the trend was to achieve lower cost, increase reliability, and improve performance. He stated that

LSI is an extension of the historical trend. A primary difference between LSI and circuit product technologies is that 100 or more circuits are contained on a single semi-conductor chip versus 14 circuits on the most advanced integrated circuit on any IBM announced product.

B. Spatz stated that for LSI to be used beneficially, its application must be concentrated on circuit blocks having high usage with internal circuits and connections and few external connections. He stated that memory is an ideal application for these characteristics. Use for CPU logic offers substantially lower opportunity for the future. He stated that Field Effect (IGFETS) integrated circuits hold more potential for successful use than Bipolar integrated circuits. The use of integrated circuits for logic was questionable. The primary advantage of Field Effect over Bipolar was stated to be the ease of fabrication and higher expected yields. The disadvantage is that Bipolar provides approximately two to three times the speed of Field Effect systems.

Piore stated there was no firm agreement between all the interested parties in IBM on whether Field Effect or Bipolar offered the best long-range potential. His judgment was that we were two-three years behind competition in the Field Effect area and that this technology would not appear in our machines before 1973 or 1974. He stated that we can match anyone in the industry on development in the Bipolar area and that we intend to keep pressing that development effort because of its good speed characteristics.

The MC agreed with Piore's recommendation that the CTC continue, as planned, to review the resource allocations being made by CD to the Bipolar and IGFETS areas and would report to the MC if necessary.

III. Hume, Opel, Kennard, Piore, Case, Gore and Knaplund entered for an informational presentation on NS Series.

A. Jones questioned why the 3.7 card I/O equipment was not being planned for use in the NS Series. Case responded that in the speed ranges required for NS, the 80 column technology was easier to build at a given cost and that demand for 80 column equipment in the speed ranges required is in the market today. He did state the small card ultimately would be our thrust. Jones took exception with this and stated he felt the small card technology should be used for NS.

IV. Simmons, Brown, and Hume entered for a presentation to approve a Real Estate proposal to purchase the Phoenix Branch office. Simmons stated the advantage of ownership in the program was $959,000 per year with a positive cash flow of 13 years and a return of investment of 21.7%. After discussion, the Real Estate proposal was approved.

V. Knaplund, Opel, and Phypers entered for a discussion of the format of the MC presentation of the Corporate Strategic Plan to the MRC. After discussion, it was agreed the format proposed by Knaplund was acceptable (attached) and that Opel would develop the preambles to be given by the MC prior to each divisional presentation to the MRC.

VI. Haskell and Phypers entered to present the details of the proposed Staff Study.

A. The MC suggested that Moodie or Evans, or both, be added, and McCracken eliminated, to the list of executives to be interviewed prior to the kickoff of the Staff Study. The remainder of the suggested Staff Study outline was approved as presented.

B. Haskell reviewed the timetable for the Staff Study as follows:

1. June—review the Staff Study approach with the executives listed for review and research past efforts of staff study work.
2. July—design questionnaires.
3. August—announce the study and begin data gathering.
4. September—analyze data.
5. October—distill and test the principles developed.
6. November—review with the MC/MRC.

After discussion, the MC agreed with the timetable as presented.

Meeting adjourned.

Attachment No. 6

PLAINTIFF'S EXHIBIT 128

BINDER QUARL.
AUGUST 1971

ROLL NO. ________

SPECIAL FEATURE OF COPY:

I hereby certify as follows:

1. I am a microfilm operator employed by BRUNING MICROFILM CORP.

2. I made accurate and complete reproductions of the records as submitted by ________ (Company Name and Address) for microfilming on the date or dates above mentioned.

3. That listed above is the roll number and the records which it contains.

4. That if any pictures have a notch punched through the edge of the frame, they have been retaken, and such retakes will appear attached to the beginning of this roll, and will be preceded by a certificate entitled: Certificate of Authenticity (Retakes); if any pictures have a hole punched through the lower left hand corner of the frame, the picture is a duplicate and should be disregarded.

5. That if there are any significant features of the records microfilmed on this roll, they will be described in my handwriting in the above space labelled. Special Feature.

6. That said microfilming was performed pursuant to and in conformance with Contract Settlement Act of 1944, Secs. 4 (b) and 10 (-) thereof and according to Regulation 11, Secs 6013.1 to 6013.0 inclusive, made thereunder by the Director of Contract Settlement or any amendments or additional regulations thereto.

________ DATE Name of Operator

REGISTERED IBM CONFIDENTIAL

AUGUST 12, 1971.

Memorandum to: Mr. G. B. Beitzel.
Subject: Quarterly product line assessment.

This Quarterly Assessment represents our department's best judgment on the status of the IBM product line in today's competitive marketplace. The report in this binder is intended both as a record of our presentation and as a reference document.

The price/performance charts reflect the recent IBM price changes, but do not consider price increases announced last week by Honeywell and Univac. Prices for the Univac 1110, the Honeywell Series 6000, and the depicted models of the HIS Series 200 should be increased by approximately five percent.

The assessment ratings are based on product versus product comparisons. In the commentary, we have attempted to reflect those additional values which we believe will be considered significant by the potential user.

P. J. LAVEAU.

Enclosure: Distribution List.

DISTRIBUTION LIST

Mr. J. H. Aitchison
Mr. F. T. Cary
Mr. T. E. Climis
Mr. F. J. Cummiskey
Mr. B. O. Evans
Mr. R. H. Fentriss
Mr. G. P. Fusco
Mr. W. C. Hume
Mr. G. E. Jones
Mr. J. J. Keil
Mr. J. G. Maisonrouge
Mr. J. P. McDermott
Mr. W. L. Noel
Mr. R. A. Pfeiffer, Jr.
Mr. F. G. Rodgers
Mr. C. B. Rogers, Jr.

PRODUCT LINE ASSESSMENT SUMMARY

System/product	Assessment	Competition
Large systems:		
	Deficient	CDC Star—100.
Model 195	do	CDC Cyber 70, mod 76.
Model 165	Equal	Univac 1110.
Model 155	do	Burroughs B6700, HIS H6080.
Intermediate systems:		
Model 145	do	RCA 6, HIS H6040.
Model 135	Superior	RCA 2, NCR C-200.
Model 30	Deficient	Univac 9300/9400, NCR C-200, Burroughs B2500, HIS H1015.
Model 22	do	NCR C-200.
Model 25	do	Univac 9200, NCR 3-100 and C-200, Burroughs B2500, HIS H115-2.
System/370 advanced function:		
Multiprocessing	do	Univac 1100 series, Burroughs B6700/B7700.
Relocate	Equal	RCA 3, RCA 7, Burroughs B6700/B7700.
Sensor base	Deficient	Control data, digital equipment, Xerox data systems.
Small commercial systems:		
T-55	Superior	HIS H115/H115-2/H125, UN 9300/9400.
T-54	Equal	NCR C-100, UN 9200, HIS H110.
Model 20	Deficient	NCR C-50, UN 9200, HIS H115/H115-2.
System/3	Equal	NCR C-50 and C-100, UN 9200, HIS H105 and H115.
IBM 6400	Deficient	Burroughs L series, Mixdord 800, Philips 350.
Sensor-based and small scientific systems:		
1800	do	General automation 18/30, alternative application approaches, mini-computers in general.
1130	do	General Automation 18/30, mini-computers in general.
System/7	do	Honeywell, DEC, Varian, Hewlett-Packard.
Storage products:		
Tape drives:		
2401 series	do	Ampex, Bucode, Texas Instruments, Potter, Telex.
2420 series	do	Potter, Telex, Bucode, S.T.C.
3420 series	Equal	Do.
Fir	do	Ampex, Potter.
Birch	Superior [1] (not rated)	No competition.
Drum and disk drives:		
2310	Deficient	Memorex; Computer Hardware, Inc.
2311	do	Memorex, Marshall, Telex, Greyhound, Talcott.
2314A/2314B	do	Telex, Memorex, Calcomp, Marshall, CDC, Ampex.
2319/IFA	Superior	Do.
3330	do	Century Data Systems.
2395	do	Advanced Memory Systems (S.S.U.).
Winchester	Equal [1] (deficient)	Telex, Memorex, CDC, Calcomp, Marshall.
Disk packs	Deficient	Memorex, Caelus, BASF, CDC.
Strip files	Equal	NCR.
LCS (2361)	Deficient	Ampex, Lockheed, Fabri-Tek, Data Products.
Main memory (S/360, S/370)	do	Data Recall Corp., Fabri-Tek, Ampex, Cogar, Weismantel, Standard Computer.
Card/paper tape/printer products:		
Card I/O	Equal	No 80-column plug-to-plug competitioton.
Paper tape I/O	Deficient	Honeywell, GE, Tally, Teletype.
Printers:		
1403N1	do	Telex, Potter.
3211	Superior	No comparable competitive product.
Canopus (MED.-500 LPM)	Equal	Data Products, Mohawk Data Sciences.
5203-3	do	Potter, Data Products.

See footnote at end of table, p. 5112.

PRODUCT LINE ASSESSMENT SUMMARY—Continued

System/product	Assessment	Competition
OCR and MICR products:		
OCR:		
1287	do	NCR; Recognition Equipment, Inc.; CDC 935; Univac; Honeywell.
1288	Superior	COC 915, COC 955.
Shark	Equal	Recognition Equipment, Inc. (Input-3).
MICR:		
Inscriber	Deficient	NCR 482, Burroughs series 100 and 200.
Sorter/reader	do	Burroughs B9134-1; OCR/MICR.
Data entry products:		
029/059	do	Univac 1701/1710 (buffered).
5496	Equal	DDC 9601 and 9610.
129	do	Univac 1701/1710 (buffered).
IBM 50	Deficient	Mohawk Data Sciences, Honeywell, Viatron
Viking 1	Deficient [1] (superior)	Keypunch-Univac; Clustered Systems-Inforex. Computer Machinery Corp.; price advantage as remote.
Data collection products:		
357/1030	Deficient	CDC, RCA.
2790	Equal	Friden Mis, Data Pathing, Inc., Solar, Burroughs TU 100/900.
Communications products:		
Communications controllers:		
27C1	Deficient [1] (equal)	ITT, Memorex, Sanders.
2702/2703	Deficient	Memorex 1270, Burroughs 1800.
27RM	Equal [1] (deficient)	Comcet 20, 40, 60; Honeywell 16 series; Varian Mini's; Univac C/SP.
27RL	Superior [1] (not rated)	Memorex 1270/1271, Interdata.
Operator oriented terminals: 2740, 2741	Deficient	Teletype Corp., Dura, Datel, Anderson-Jacobson, Memorex 1240.
Low/medium speed batch terminals:		
1050, 2770	do	TTY ASR, Datel 31, Univac DCT 500/1000, GE Terminet 300, Memorex 1280.
3735	Equal	Burroughs TC series, Compat 88-23, Cogar System 4, Victor Nixdorf 820.
27AX	Deficient	Memorex 180, GE Terminet 300, TTY KSR/4210
High-speed terminals: 2770, 2780	do	Data 100, Remcom, Univac DCT 2000.
Processor terminals:		
System/3	Equal	Univac 9200.
1130, S/360-20	Deficient	HIS model 5, Data 100 78-2.
Remote display terminals:		
2260/2265	do	Univac Uniscope 100, Datapoint 2200, Digivue 2000.
3270	Equal	Univac Uniscope 100, Datapoint 3360.

[1] Change from previous assessment which is in parentheses.

Attachment No. 7

CIVIL ACTION—69 CIV. 200

UNITED STATES DISTRICT COURT, SOUTHERN DISTRICT OF NEW YORK

UNITED STATES OF AMERICA, PLAINTIFF

v.

INTERNATIONAL BUSINESS MACHINES CORPORATION, DEFENDANT

NOTICE OF MOTION

PLEASE TAKE NOTICE that on the grounds set forth in the attached motion and supporting memorandum, plaintiff will move this Court before Chief Judge David N. Edelstein, at the United States Courthouse, Foley Square, New York, New York, at 10:00 a.m. on April 14, 1972, or at such other time or place as may be set by the Court, for an order requiring defendant to produce documents delivered by it to a third party, Control Data Corporation, in response to process of another Federal Court, as to which IBM seeks to invoke a doctrine of inadvertent waiver.

Dated: April 7, 1972.

GRANT G. MOY, JR.,
Attorney, Department of Justice,
Washington, D.C.

U.S. GOVERNMENT MEMORANDUM—DEPARTMENT OF JUSTICE

OCTOBER 30, 1970.

File: 60–235–38

From Burton R. Thorman, Assistant Chief, Special Litigation Section.

Subject: U.S. *v.* IBM.

A xerox copy of the following document was found by me on October 29, 1970 in the files of R. A. Pfeiffer, IBM Director of Marketing. A stamp indicated it was a "CSM Study" not to be reproduced. The initials "HAF" are probably those of Hillary F. Faw, IBM Director of Business Practices, part of the corporate staff. Text follows:

HAF 11/21/69.

THOUGHTS FOR CONSIDERATION

The liability of IBM's risk lease is dependent on price leadership and price control.

By means of price leadership, IBM has established the value of data processing usage.

IBM then maintains or controls that value by various means: (timing of new technology insertion; functional pricing; coordinated management of delivery; support services and inventory; refusal to market surplus used equipment; refusal to discount for age or for quantity; strategic location of function in boxes; "solution selling" rather than hardware selling; refusal to support subsequent use hardware, etc.

Unbundling has created a new threat to IBM's price control.

By eliminating fixed price solution selling of hardware eventually leading to increased price competition.

Functional pricing already under pressure because of OEM activity. Unbundling will increase that pressure.

Equalization of subsequent use adds value to existing third party inventories.

Seriously reduced capability to maintain—ahead of supply.

Legal problems are emerging as a result of certain practices which are key underpinnings to price control.

Refusal to market used machines and parts. Refusal to sell bills of material. Maintenance parts prices.

The key underpinnings to our control of price are interrelated and interdependent. One cannot be charged without impacting others.

These interrelationships are not well or widely understood by IBM Management. Our price control has been sufficiently absolute to render unnecessary direct management involvement in the means, [the next five or so lines were deleted from document]

The D. J. Complaint specifically covers varying profit margins and an intensive investigation of this issue would reveal the extent of our price control and its supporting practices. Such a revelation would not be helpful to our monopoly defense.

If IBM's price control is seriously threatened, either from the market or (because of unbundling) or from legal exposure (because of the supporting practices) or from the D. J. (because of demands for remedy) it is necessary that IBM Management fully understand its import in order to decide.

> Negotiations' strategy with D. J. good vs. bad practices remedies good vs. bad structural remedies (or) decision to litigate.

Pricing Approach to New Systems.
Reduction of Legal Risk relating to practices.

RECOMMENDATION

Assemble a small, knowledgeable, secure group to think through these issues, particularly in their interrelationship—define the emerging environment and the various new forces which indicate significant new change—and map the rudimentary elements of strategy or alternative strategies for consideration by Management.

It is to be noted that the deleted portion above probably is based on a claim of privilege, counsel's usual basis for excluding material.

A xerox copy of the document has been ordered.

Attachment No. 8

This forum is offered for readers who want to express their opinion on any aspect of information processing. Your contributions are invited.

The Forum

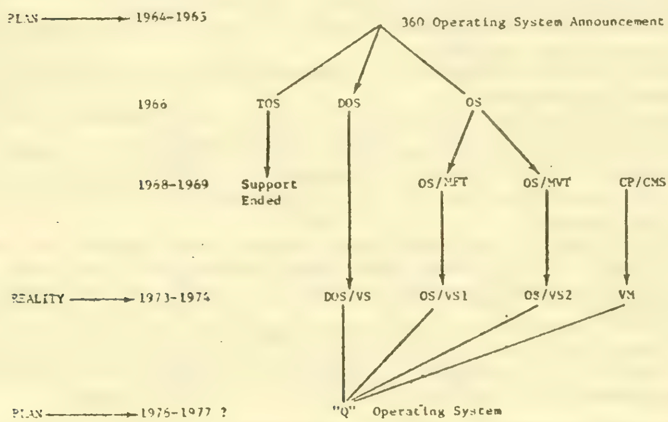
IBM'S OPERATING SYSTEM MONOPOLY

IBM currently monopolizes the development and support of IBM operating systems. This monopoly, which started almost 10 years ago, has played continuous havoc with IBM 360/370 users. Operating systems are almost unanimously viewed as being the most critical element of any computer system: they permanently occupy large portions of memory; they are responsible for all I/O queueing, scheduling, device allocation, and resultant computer throughput; they are responsible for the support (or non-support) of all peripheral devices; and they control memory allocation, multiprogramming and, in the case of virtual memory, page accessing and allocation. Application programs are dependent on the unique resources of operating systems; when the resources are changed or support is discontinued, the user is at the mercy of the operating system's developers and supporters.

In 1970, the operating systems were the *one* piece of software that IBM chose not to unbundle. Was it an act of kindness? IBM doesn't charge its customers for DOS, DOS/VS1, OS/MFT,OS/MVT, OS/VS1, OS/VS2 or VM/370 and surely IBM wants to increase its revenue. They charge for compliers, sorts, data manage-

IBM 360/370 OPERATING SYSTEMS

FAMILY TREE



ment packages, and other pieces of system software (all of which have competition). Why wouldn't IBM want to increase its revenue by charging for operating systems?

IBM doesn't charge for them simply because it is significantly more profitable in the long run to lock customers into inefficient operating systems and lock out competition. After being trapped, the computer user "lamb" is strategically led to the next generation of IBM operating systems. 360 users have no choice but to move to the 370 line, because new devices are supported only on the 370 operating systems. 370 DOS and OS users are led to VS operating systems because support of the current operating systems is discontinued. "Functionally stabilized" is IBM's way of telling users it will no longer improve on DOS, OS/MFT, and OS/MVT—a slow death no matter how you look at it.

Competition does not happen spontaneously—especially in the area of operating systems. Sure, some software companies can "pick up the crumbs" and try to sell support and enhancements to IBM's "free" operating systems. But the harm

is already done—there is no effective or economical way for a would-be competitor to break into the field. New operating systems *are* being planned and most users won't stay with current "free" operating systems if they have to buy support from some non-IBM firm. Besides, soon there will be that new IBM state-of-the-are free operating system and it'll solve all of those problems of the past. . . Wanna bet?

Competition and antitrust laws made IBM cut the price of its peripherals and memories. But there is *no* operating system software competition so far, because the monopoly has not yet been challenged.

Consider this hypothetical situation: in 1964 IBM announced the 360 at an average cost of $10,000 per month; IBM also announced an operating system software package at $1,000 per month. With IBM predicting sales of 20,000 computers, and third party leasers predicting 10-year life spans for 360 computers, the total 10-year revenue for the 360 hardware line was predicted to be $24 billion. During the same 1965–1975 period, the operating system software package market alone was predicted to be $2.4 billion. By 1967, three software companies had developed compatible operating systems to sell for $750 per month; they were compatible, operated in half the space, and provided faster throughput. IBM responded by announcing a new version of the operating system. The wheels of competition keep turning, and the needs of the user community—as well as those of the industry—are served.

But look at what we have in 1974: IBM locking in its customers with free vs operating systems and IBM users facing obsolescence of their 360 hardware and current operating systems, and no competition in sight. It's all going to happen again, two to five years from now, with IBM's new, and as yet unannounced, "Q" operating system. Where is the Justice Department and where are the voices of the users? IBM's 360/370 line of computers was successful in spite of its inefficient and error-prone operating system. Talk about the need for conservation and improved productivity! It would be an interesting exercise for an economist to calculate the resources that have been wasted because of the marginal operating system software that IBM has produced and supported over the past 10 years.

In defense of its position in the TELEX case,* IBM recently stated that antitrust laws exist "Because through competitive battles resulting in innovation and price reductions, the consumer benefits." But, IBM, may I ask one simple question: how do you propose that those "competitive battles" in the field of operating systems be waged with only one side willing to fight? It still may not be too late to introduce competition into the next generation of operating systems, but time is running out.

There's no technological reason why IBM can't unbundle their operating systems; CDC has announced that they will charge for *their* operating systems. Obviously, free operating system software is merely a marketing decision and unless IBM is pressured into changing its policies, things will remain, unfortunately, the same.

—Martin A. Goetz

Mr. Goetz is a vice president of Applied Data Research, and director of its Software Products Div. Past president of the Software Industry Assoc. and of ADAPSO, he is the holder of the first U.S. software patent.

Attachment No. 9

PLAINTIFFS EXHIBIT 472

APRIL 20, 1970.

Memorandum to: Mr. P. J. Rizzo,
Subject: Memory Pricing.

I am making this a separate memorandum because I would like to have you look at it separately and not as part of the Model 50 maintenance pricing issue. Using the Model NS 2 as an example, Group is looking forward to a profit at 48 months of some 35–63% on memory with a profit of 25% on the CPU.

I am told that the memory represents one-third of the revenue of the combination and the CPU two-thirds. At the above profit level for memories, they estimate they will be 30% above competition in price.

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*Brief of International Business Machines Corp. presented at the U.S. Court of Appeals, Tenth Circuit, Feb. 7, 1974, p. 45.

Originally, I advised them to price memories and CPU's both at 30%. They readily agree that CPU's cannot be easily duplicated whereas memories can be easily duplicated on a plug-in basis.

I would, therefore, conclude that we should have 25% profit on memories, higher prices on CPU's and up with an overall profit in the 62% range.

Again, I am sure it is more complex than this simple arithmetic, but why should it not be studied this way to see what the end result will be.

T. V. LEARSON.

Attachment No. 10

PLAINTIFFS EXHIBIT 391A–083

JUNE 25, 1971.

Present: Mr. T. V. Learson, Mr. F. T. Cary, and Mr. S. L. Reed.

I. 1:30 SIGNIFICANT ITEMS

A. Systems 370 pricing adjustment proposal discussed prior to presentation by DP Group. FTC concerned about sequence and timing of events in World Trade. Might not make good business sense to independently implement a fixed term lease followed shortly with the price adjustments. Open and Rizzo called in to discuss the financial impact of the WTC fixed lease plan. No decisions made pending review of final recommendation.

II. 1:50 370 PRICE ADJUSTMENTS

J. R. Open, P. J. Rizzo, N. deB. Katzenbach, G. B. Beitzel, T. C. Papers, Jr., B. Goldberg, G. E. Jones, F. J. Cummiskey.

DP Group requests MRC review of their preliminary conclusions and approval of the general direction of their work on the pricing of CPU and Memory components of current and future systems.

Increased price performance of CPU/Memory combination is key to maintaining revenue. Growth of technology will result in the combination of the two functions into one box. FET memory is solution to lower costs and packaging problems.

Interim exposure to competition with present price performance.

Adjusting present CPU/Memory price relationships recommended as best solution among options considered. Recommendation is to reduce price of memory in direction of ultimate FET slope and increase CPU prices accordingly.

Proposed plan would result in rental increases ranging from 25% to 50% for System 370 memories and CPU increases in the 20% to 25% range. Purchase multipliers would remain the same as present and purchase prices would be adjusted accordingly.

WTC (Cummiskey), on balance, sees minimum problems with approach. Slight exposure to triggering price control board investigations but problems are manageable.

During the presentation MRC discussions and questions centered around the following:

Alternative ways to accomplish objectives. A fixed term lease approach for memory and CPU's was discussed in detail. It was Group's judgment that this would prematurely erode the FTP concept to the entire product line and, in addition, would be ineffective unless accompanied by some degree of price action.

Problems with separating System 360 actions from System 370 actions. Group's final recommendations on System 360 and System 3 pricing actions were not completed yet but there appeared to be no problems in separating System 360 from System 370. Group will include this analysis in their final plan.

Strategy to encourage purchase of memories. TVL commented that since memories are subject to fast technology changes, it needed to be a purchase business. A variation to the proposed plan to encourage more purchase (i.e. same recommended purchase reduction for memories but don't reduce rental as much) was discussed. Group's initial judgment was negative they will investigate more thoroughly.

Concept of memory price slopes. FTC discussed his concern over the divergency of proposed price slopes between 021, M9, and FET memories. Feels FET memory

must be lower. Also feels strongly that we must get away from the concept of slope pricing on memory inside combined CPU/memory box. Over time, as costs become less, we should offer less memo size options and larger increments. Proposes that it might make good business sense to tart in this direction by increasing the minimum entry memory size on all models of the 370 System. Group agrees to examine this in their analysis.

Exposure to competitive CPU's. Group was asked to assess the exposure to competitive CPU's caused by the proposed CPU price increases. Their judgment was that a competent, well financed, competitor could get to the marketplace within 12 to 24 months.

Marketplace problem. Group was asked to include in their final recommendation an assessment of any marketplace phenomena such as GSA exposure, the effect on recent purchase customers, announcement timing, etc., that could affect the decision.

The session ended with Group being authorized to continue work in the same general direction, with emphasis on developing a unified total strategy and a more exhaustive analysis of options. They were asked to return as soon as possible with their recommendations.

III. 3:50 P.M.—WTC FIXED TERM LEASE

J. R. Opel, P. J. Rizzo, N. deB. Katzenbach, G. E. Jones, F. J. Cummiskey, K. Cassani, N. L. McElhatten and R. H. Fentriss.

World Trade requests MRC approval to announce a fixed term lease plan in major countries on July 6, 1971.

Recommended plan is same as announced domestic plan relative to terms, discount percent, renewal and termination.

Plan differs from the domestic contract on protection against price changes. World Trade would offer price protection for 12 months only, even on 24 month contract, to provide flexibility in responding to inflation/revaluation problems.

Would offer same products as domestic.

Announcement timing for small countries (Latin America, SE Asia, Africa, Middle East, etc.) would be deferred for 60–90 days pending evaluation of soft currency problems, contract preparation and time for training.

Country uplifts on 2314 would be adjusted downward from 4–6% depending on present level.

MRC discussion and concern centered on the following items:

Price protection

Contractual and marketing mechanics of price increases to customers operating under a 24-month fixed term lease agreement were discussed at length. All concluded that problems were manageable and flexibility was necessary.

Products offered under fixed term lease

FTC asks that reasons for offering exactly same products as domestic be examined closely. Not necessary for action to be automatic. World Trade (Cummiskey) defends on basis that rationale for including same products holds in major countries for same reasons as domestic. Excluding printers looked at most seriously, but rejected.

Timing

FTC questions urgently to move so soon in light of a possible opportunity to combine this action with probable System 370 pricing changes. WTC (Jones) defends on basis that expectation of announcement in marketplace causing decisions to be delayed and customer confusion. Affects competition as well as us. Jones convinced action must be immediate.

Session concluded with MRC giving approval for World Trade to proceed with implementation of the plan as presented.

IV. 4:25 PERSONNEL RECOMMENDATIONS

W. E. Burdick, W. R. Liebtag, H. P. Kneen, R. W. Hubner, J. R. Opel, E Buhl, S. Blasgen.

A. Personnel makes information presentation on possible design of a special one time "retirement" plan which could be used to help alleviate excess manpower problems.

Employee who voluntarily leaves (resigns or retires) may receive special payment, based on salary amount up to $30,000 a year. Would be paid at rate of 75% of salary for first six months, then 50% of salary until the earlier of 1) attaining age 65, or 2) receiving a predetermined maximum total payment. Maximum would range from 24 months pay for employees with 25 years service down to 9 months pay for employees with 10 years service.

Employees would be subject to "no compete" clause during period of payments.

Possible criteria for implementation could be all IBMers eligible for early retirement of all IBMers with 25 or more years of service. Other selected groups could be considered but must be clearly identifiable with skill and/or geography, and business problem must be clearly identifiable with group selected.

Plan would be only available to employees for a 90 day period at which time offer would end.

If plan were adopted for 25 years service and over, Personnel estimates a yield of approximately 1400 people. Estimated savings during first year would be approximately $3 million. Over four years approximately $39 million.

MRC discussion centered on examination of various criteria for eligibility and associated yields. Decision made to restrict the plan to 25 years service and over at the present time but work should continue on how to extend plan to specific skill/location groups on a selected basis should circumstances become necessary. Personnel was asked to initiate appropriate staff work to prepare plan for announcement and return as soon as possible with final recommendation.

B. Personnel reports back to MRC with their recommendations on changing separation allowances as an inducement to encourage attrition. (Buhl, Blasgen, leave—others remain).

Personnel recommends no change at the present time on the basis that both internal and external conditions are bad for this kind of action. Plan also has minimum flexibility to address right segment of employees.

Current study is under way to adjust our separation allowance to be more in line with industry practices. This will continue and Personnel will return with final recommendations.

MRC accepted recommendations as presented.

C. Personnel presents their recommendations on plan to require all deferred vacations to be taken in order to alleviate manpower overages.

At present, weeks in excess of two may be deferred up to a maximum of eight. Concern is lack of company control over current deferrable vacation and cumulative vacation deferred to date.

Present plan does allow flexibility in adapting to business conditions (i.e. in in 1966 encouraged deferral, in 1971 encourage use). It also permits extended vacations like steel without attendant costs.

Recommendation is to defer timing of any actions until 4th quarter 1971. By that time we will have a better assessment of voluntary use of 1971 vacation already being encouraged, and a closer look at the business needs. Also would be better from stockholder relations standpoint and would provide adequate employee notice.

Plan would require taking of full 1972 vacation. We would also encourage further use of "bank" in 1972 and reemphasize business needs in "About Your Company" booklet.

MRC discussion centered on history of vacation deferral plan and flexibility of present set-up. FTC expresses concern that our present plan for low service employees too lush. Personnel given approval to proceed with recommendations as presented but to give additional consideration to changing options available to low service employees. They should return for MRC approval prior to taking final action.

Attachment No. 11

PLAINTIFF'S EXHIBIT 122

	Actual to date	1971	1972	1973	1974	1975	1976	1977	B al.	Total program	Percent of revenue
Revenue:											
Lease	0	63	5,535	15,067	25,743	34,060	33,478	40,536	85,671	240,960	81.9
Purchase	0	648	15,012	12,096	9,664	7,172	6,660	1,764	432	54,468	18.1
Total revenue	0	711	20,547	27,963	35,013	42,052	40,138	42,300	86,103	301,428	100.0
Manufacturing cost	0	1,591	10,557	9,714	9,000	7,305	5,054	343	88	43,052	14.5
Element	0	0	0	0	0	0	0	0	0	0	0
Total production	0	1,591	10,560	9,714	9,000	7,305	5,054	343	88	43,052	14.5
Fld Recon	0	0	0	55	306	674	986	1,1113	51	3,258	1.1
Labor	0	51	3,183	2,140	3,117	3,467	113	2,787	5,991	23,307	7.8
Parts	0	8	91	235	391	540	662	700	1,647	4,278	1.4
LCP	0	2	225	370	219	203	0	0	0	1,027	8.3
Training	0	62	786	660	155	231	171	0	0	2,014	.7
Other	0	0	0	0	0	0	0	0	0	0	0
Total FE	0	117	3,285	4,243	3,882	4,561	3,044	3,416	7,635	30,786	10.2
SDD development	0	2,024	0	0	0	0	0	0	0	2,024	.7
Prod eng	0	170	331	192	122	41	32	0	0	380	.3
Programing	0	756	0	0	0	0	0	0	0	736	.3
SCR	0	143	578	329	115	90	14	0	0	1,244	.4
Prod test	0	300	210	64	0	0	0	0	0	574	.2
Total SDD	0	3,399	1,110	585	237	99	40	0	0	5,437	1.8
Other direct	0	0	0	0	0	0	0	0	0	0	0
Total direct	0	5,107	14,969	14,537	13,485	12,630	2,730	4,873	7,777	33,123	27.6
Profit contribution:											
Cash	0	−4,396	5,578	13,364	22,128	23,413	35,409	37,422	79,326	218,245	72.4
Depreciable	0	−3,276	11,460	16,370	23,119	23,370	34,304	33,119	75,356	218,246	72.4
Percent	0	−410.5	55.9	58.5	64.9	67.5	73.7	79.3	37.2		
Apportionments										106,703	35.4
Product contingency										4,092	1.3
Total, all costs										193,389	64.3
Net profit before taxes										107,538	35.7
Profit lease (percent)											35.5
Profit purchase (percent)											36.9

Attachment No. 12

MINUTES OF THE MANAGEMENT REVIEW COMMITTEE

PLAINTIFF'S EXHIBIT 387–021

APRIL 23, 1971.

Present: Mr. T. J. Watson, Jr., Mr. T. V. Learson, Mr. F. T. Cary, and Miss Jane P. Cahill.

I. 2:00 SIGNIFICANT ITEMS

A. WTC executive resources—FTC discusses organizational and mission changes required if organizing by systems definition. FTC also to think about staffing in the business practices area.

B. TJW, Jr. wants: Might also do same thing in financial area with Rizzo.

II. 2:50 DP MARKETING, PRODUCT PRICING AND POLICY RECOMMENDATION— G. B. BEITZEL, P. J. RIZZO, J. R. OPEL, T. C. PAPERS, JR., S. L. REED

1. Additional use recommendation—all 370 CPU's at 10%.
2. Reduce all other 370 outboard types from 10 to 2%.
3. Hold 360 at 10%.
4. Reduce 1400/7000 types used on 370 from 30% to 10%.

TJW, Jr. wants clear understanding that company swallow whatever financial pills required now and get ready for the future. We can't have ourselves mesmerized by the balance sheet—irrespective of financial considerations of one or two years—must return this business to a growth posture and operate accordingly.

A. Discussion on additional use charges continued. Currently we service all of our rental machines. A night per call charge over time could certainly effect prime shift control. TJW, Jr. again stressed need to make the hard decisions today so that some problems don't have to be faced again and again down the road.

Attachment No. 13

PLAINTIFF'S EXHIBIT 67

TASK FORCE TO REVIEW OEM PC FILE SUPPLIERS

Objective: Improve accuracy of OEM file projection—installed inventory '70–'73.
Task Force Members: R. R. Nern SDD, Chairman; T. C. Cooper, DPD Forecasting, H. M. Silveira, OPG Adv. Prog., G. J. Fassig, DPG Fin., D. R. Hunter DPO, K. J. Gaffney DPD Forecasting.
DEM Suppliers to be Reviewed: Memorex, Telex–ISS, Century, COC, Potter.
Target Completion Date: October 30, 1970.

AREAS TO BE REVIEWED

I. Analysis of OEM 2314 Orders/Installations to Date

A. Installations by—Branch Office
Customer 7 Digit Account Number
CPU Model
Number of CPU's in Installation
OEH 2314 On Leased CPUs On Customer Purchased CPUs
By OEM Supplier
Other IBM 2314's Exposed
In Account: CU, Drives
Total Points

B. Correlation of 370–3330 Orders With OEM 2314 Installation.

C. Analysis of OEM 2314 Backlog as Reported to Comstat—
By OEM Suppliers
By Branch Office
By Customer

* * * * * * *

B. Announcement of PC 3330 Equivalent.
1. Estimated Announcement Date.
2. Estimated FCS Date.

C. Announcement of PC 2314 Enhancements.

V. FINANCIAL

A. Cash Flow.

1. OEM PC Suppliers Arrangements with Finance Companies.

(*a*) Finance Co. Agreements—
Finance Company
S Commitment
Obligation to Remarket (Product Life Required)
Expiration of Agreement
% of PC Suppliers Production

(*b*) Effect of 2314 Price Changes

(*c*) Effect of OEM PC 3330 Announcement on Suppliers—
2314 Life
2314 Production

B. Estimate of 2314 Product Cost.

1. 2314 CU.
2. 2314 Drive.
3. 2319 Equivalent.

C. OEM Profit. How Low Can OEM PC Supplier Go on 2314 Prices

D. 3330—Estimated 3330 Prices:
1st Year.
2nd Year.
3rd Year.

Attachment No. 14

PLAINTIFF'S EXHIBIT 323

IMB CONFIDENTIAL

JUNE 1, 1971.

Memorandum to: Mr. T. C. Papes.

Subject: Fixed Term Plan: MRC Presentations—May 20 & May 25, 1971.

Attached are the charts we used for the two subject presentations.

I am putting together a package of backup and prior MRC presentations which led up to our decisions on the Long Term Plan.

J. G. POWERS.

But, PCM Corporate Revenues Lower:
—No funds for mfg., eng.
—Dying company!

	Renewal	Follow-on
P. cost	0	18
Eng	0	7
Mktg	10	10
Svc	10	10
G. & A	10	15
Profit	25	30
Rev./price	55	90

Follow-on gets
—More revenue + profit $ for company
—Mfg, Eng funded
—Growing, profitable company

Conclude: Don't go for renewal if you can sell follow-on—limited selling old line to new customers.

(Attachment No. 15)

PLAINTIFF'S EXHIBIT 396–037

JUNE 18, 1970

Present: Mr. W. C. Hume, Mr. G. E. Jones, and Dr. D. R. McKay.

I. SIGNIFICANT ITEMS

1. Opel reported briefly on the Levin-Townsend situation.

2. McKay and Phypers reported on the content of the Poughkeepsie meeting as it applied to the management of the SE resource.

3. Jones reported his conversation with Opel on Data Processing Systems with specific concern for CMIS and the fact that the presently planned scope and expense was not necessary. It was agreed that this would be addressed later in the presentation.

4. McKay reported on plans to cover NS–ASCII with the Bureau of Standards stating that they were satisfactory. It was agreed that this should be covered wih Dr. Grosch as well.

5. Hume reported on his audit of Sales Schools at TVL's request. He stated that the curriculum and the quality of the instructors was very good. He further stated that morale among the students was not as high as it should be because many of them were somewhat reluctant transfers from SE. He further stated that recruiting of instructors was becoming more difficult because of the moves involved and the relative drop in prestige of the position.

II. ECONOMIC OUTLOOK

Knaplund, Grove, Karchere, and Wills entered. Karchere stated the outlook keyed Federal revenues and assumed continued moderate increase in state and local taxes no Federal Income Tax increase with the exception of Social Security.

He reviewed Government spending over the period 1959 and projected through 1979, a percentage of GNP and predicted that whereas defense spending would level off, expenditures for other purposes would continue to rise. He stated that the only basic changes since the last outlook were that unemployment rates and wage increase estimates for 1971 had been increased. He stated that he felt that the Administration game plan was sound and illustrated this by the history of relationships between unemployment, cost of living, and price increases stating natural forces on the economy would bring current imbalances into better line over the next 18 months.

Attachment No. 16

PLAINTIFF'S EXHIBIT 387–090

(MC Minutes of 6/6/72)

* * * * * * *

Truex then presented the 725 marketing plan for WTC. He reviewed the marketing approach, several case studies, the announcement implementation plan, and key marketing strategies which were similar to Domestic.

Since this was an informational presentation, no decisions were requested or made by the MC.

12:35 P.M. Morning Session Adjourned

IV. 2:05 P.M. FSD GOALS

Attending: J. B. Jackson, G. B. Beitzel, W. C. Bentson; D. G. Thoroman, A. Katz, H. L. Kavetas.

The purpose of this session was to present for MC approval the FSD 1972 Goals Plan for the 1972–76 strategic period.

As background, Jackson reviewed an assessment of the international and domestic problems along with contemplated U.S. Government responses and national security expenditures as a percent of GNP. Security expenditures were projected to continue to decrease to somewhere between 3% and 6% of GNP by 1976, with the key dependency relating to the outcome of the 1972 national election. Key international problems were described the Viet Nam war entering a new phase, unstability of the Middle East, growing SS–9 missile and Soviet naval threats, and success of strategic arms limitation talks. Anticipated U.S. responses included building limit ABM capabilities, building new sea-based missile systems, modernization of the U.S. Navy, continued purchase of new tactical aircraft, and continue low key space program with emphasis on international programs and domestic benefits. Domestic problems included expanding systems requirements for postal service and air traffic control, increased emphasis on general welfare and law enforcement, environmental control, and urban traffic control. Attendant responses included new enabling legislation, massive new funding, and increasing responsibility of state/local levels for general welfare.

Jackson then presented the FSD 1972–77 Goals Plan in terms of sales, sales by business area, main thrust programs (airborne warning and control systems, advanced bomber, hardsite, undersea launched missile system, shuttle, and advanced airborne command post), manpower, revenue, NEST, margin, and ROI. (see attached charts for key elements) unfavorable to World Trade. First, a late announcement on NS–O and secondly, the lack of funded plans for low end education aids and programming techniques. He concluded by covering a number of decisions which were felt to be uniquely favorable to World Trade. All agreed that the system is working well in regard to worldwide development and that the lack of escalation results from a sound system.

Attachment No. 17

PLAINTIFF'S EXHIBIT 386–005

(MC minutes of 1-22-70)

* * * * * * *

VI. The DP Group representatives and Phypers left and Witham entered to cover *Balance of Payments*. Witham reviewed our favorable *balance of payments* position as well as our present and future difficulties in securing sufficient funding for overseas investment. AKW is calling on Secretary of Commerce, Stans, on January 27 to cover this matter as well as Eastern Bloc trade. His plan had been to point out the very real difficulties that we face resulting shortly in adverse effects on the U.S. balance of payments problem. The MC determined that our case is irrefutable and that this results from our kind of business, i.e. rent and is therefore not representative of American business as a whole. As a result the MC will strongfily urge that Mr. Watson be accompanied by Mr. Witham on his call and that his case be based totally on IBM. The MC exlpored other alternatives such as discussions with Senator Javits, the CEA, etc.

In summary, all agreed that our position is absolutely right not only for IBM but for the nation and that it was imperative that Washington clearly understand this. The MC will reconvene on this matter following the call on the Secretary of Commerce.

Meeting adjourned.

(Attachment No. 18)

GREYHOUND COMPUTER CORPORATION, INC., PLAINTIFF-APPELLANT

vs.

INTERNATIONAL BUSINESS MACHINES CORPORATION, DEFENDANT-APPELLEE

PLAINTIFF'S EXHIBIT 97

Please destroy
when finished

Strictly Confidential

September 21, 1967

Memorandum for: Mr. F. T. Cary, Mr. J. R. Opel, and Mr. D. M. Piccone
Subject: Purchase Considerations

Attached is a statement of Finance's view of the important considerations of purchase.

Many questions are unanswered, but the basic points have great validity. I thought these points would be helpful to you.

/s/ Ted
T. C. PAPES.

TCP: AM
Att.

Purchase Considerations

I.—Lease/Purchase—Effect on IBM

1. The higher the proportion of lease business, the more stable the company's growth.

2. There is a certain portion of the computer market that is "hard core" purchase. It is in the company's best interest to compete for and achieve as high a share of that hard core purchase market as competition will allow.

3. We believe that through "purchase emphasis" or "purchase de-emphasis" marketing programs we have the capability to influence the level of purchase somewhat either above or below a "natural level"; however, the "natural volume", influenced by a number of factors, is subject to variations that considerably exceed the extent to which we can influence the purchase level.

The principal factors influencing the "natural level of purchase" are:

a. Availability of financing

b. Interest rates

c. Relative position in the product life cycle

d. Market confidence, or lack thereof in succeeding equipment generation compatibility with the present generation of equipment.

e. Level of sophistication of the customer (excluding leasing company purchases)

f. Tax provisions (i.e., investment tax credit)

g. Relationship of lease and purchase price

h. Market confidence in the hardware performance (high up time) and accompanying software packages.

4. It is probable that increases in the purchase level have the effect of decreasing the average rental life of the system being purchased.

5. In most instances, at the time of announcement, profitability of a purchase unit exceeds the profiitability of a rental unit (at the average rental life) by approximately 10 percentage points of profit. This is due to the relatively high purchase multiplier used to establish the purchase price from what is basically a rental pricing exercise.

A further differential can be derived from evaluating the relative "profit flow" from a purchase transaction versus a lease transaction and considering those profits to be re-invested at 6%. This differential represents approximately 5 percentage points of profit.

For each month that the lease unit exceeds the average rental life, that additional revenue stream represents approximately 2 percentage points of additional profit, on a total program basis, for that unit.

6. A predominant lease market places the greatest financial strain on the competing equipment manufacturers. A significant unknown regarding the purchase phenomena is the extent and ultimate fluidity of a used equipment market. Taken to its theoretic maximum limits, a completely fluid used equipment market would have the same effect on the "customer purchase" segment of the inventory as is effected by the "leasing company" segment of the inventory.

7. The greater the level of outright purchase, the more control or more insulated we are from influence by competition as to the rate of technological change.

8. It is probable that a reasonable level of purchase early in a product program has a stabilizing effect on the market reception of the new product.

9. Though the currently available statistics are inadequate for a complete evaluation, it is probable that purchase customers grow more slowly than lease customers. Some of the factors that make evaluation difficult are as follows:

a. The growth pattern for purchase customers is not complete until the potential for "fire sales" of upgrade boxes at the end of a product cycle has had its effect.

b. The "CPU growth pattern" evaluation is too narrow. The statistics must be developed to allow evaluation of the total account. These statistics relative to the total amount would also shed light on the question, and the probability, that the purchase customer would have had a smaller initial system configuration had his decision been to lease.

10. It is probable that the lease customer requires a greater amount of sales attention in order to protect the lease inventory. This point bears on relative profitability.

11. The importance of varying levels of purchase on cash flow requirements is a significant consideration.

II.—Leasing Companies—Effect on IBM

1. It is probable that the vast majority of the points purchased by leasing companies will remain on rental for a period sufficient to represent a significant loss of profits by IBM from a total program point of view. This is without regard

to the relative profitability on the transaction actually earned by the leasing companies. The point here is that once installed the marginal cost of keeping the equipment on rental is relatively low, which significantly reduces the potential for price improvement at the installed performance level to the degree necessary to win back the business.

2. In many instances price, policy or product strategies to compete with an acceleration of the leasing company trust are either excessively detrimental to our main stream rental business profitability, or are counter to what represent meaningful strategies to meet the competition of the other equipment manufacturers. The greatest risk faced by the many new systems leasing companies is that of allowing their uninstalled inventory to increase beyond a minimal level. In most cases an uninstalled inventory level of 10%–15% can wipe out any book profitability.

3. The overall effect of leasing companies on the computer market will be to deter technological change and eventually erode the overall profitability levels of the equipment manufacturers.

PLAINTIFF'S EXHIBIT 99

June 23, 1969
2B Harrison
30–613
Declining Purchase Price
Mr. F. T. Cary

Frank, the subject of declining purchase price has at various times been reviewed. From these reviews, it has been concluded that although it does make economic sense, an average purchase price is a more advantageous approach to doing business for the following reasons:

1. The potential negative impact on leasing companies through a devaluation of their inventory.
2. The potential loss of revenue and profit to IBM, caused by lower purchase quantity in the early years of the program, and resistance to increase original price to level needed to offset subsequent declines.
3. Pressure to decrease lease price over time.

Should you care to discuss any of these points in more detail, I will be happy to review them with you.

T. C. PAPES.

TCP/crp

PLAINTIFF'S EXHIBIT 111.

IBM Confidential—Not To Be Reproduced.

January 17, 1968

Memorandum to: Mrs. F. T. Cary, Mr. G. B. Beitzel.
Subject: Financial State of the Union

This report is the last one covering 1967, and I will try to give you our best viewpoint of the business as seen at this time.

1967

On balance, last year was a very good business year. Certainly profits were good, growth was satisfactory, costs were in sound condition, expenses were reasonably well managed after a rough start in FED, reliability and serviceability factors were improved, manufacturing schedules were properly adjusted to the rate of market acceptance, manufacturing inventories were reduced and brought under better control, and our accounts receivable position improved, except for the uncontrollable situation with GSA. On the negative side of the ledger there clearly was too high a level of outright sale, we did not install enough systems, we did not sell enough new accounts, our service time and costs are still too high, our field administration problems are still with us, and we lost the Air Force order. So much for history.

1968

This year we face many new challenges requiring creative, flexible management response. We should not see a major issue or problem develop in the adequacy of our annual growth and profit performance. However, we are facing a severe quarter-to-quarter performance problem which could become acute in terms of public understanding. It is reasonably clear that we will have a very sharp increase in the first quarter of 1968 as compared to the first quarter last year. By the fourth quarter of 1968 our plan would have us showing an absolute

decline versus the fourth quarter of 1967. This is entirely due to the dynamics of equipment sale in which we are facing the possibility of another overrun this year. Regardless of the development of an overrun, we will have the quarter-to-quarter problem. This is because our 1967 first quarter had a modest equipment sale, our 1967 fourth quarter had a tremendous sale, we expect similarly to have a continued high level in the first quarter of 1968, and we expect it will have tapered off by the end of the year giving us the decline problem at that time.

The major clouds on the horizon for this year are the continued erosion of our rental inventory, softness in the backlog, pressure for higher product development expense money, the rapid growth of Information Systems throughout the Group, a need for further reliability and serviceability improvement.

Other concerns include the expected difficult GSA negotiation, the need for accounts receivable recovery in the Federal arena, some new technology management problems, the challenge to retain key personnel, and the maintenance of a competitive position in the marketplace against possible new announcements by other members of the industry.

1969

Here we have clear signs of trouble which seem unavoidable to a great degree. As 1968 performance trends upward, our comparison of 1969 over the preceding year become worse. The potential year-to-year decline can grow from the presently anticipated nominal amount to a number well in excess of $100 million if we go toward the high end of the range of equipment sale in 1968. The aforementioned pressure for higher development expenditures this year will be a serious problem in terms of going rate in 1969. The backlog difficulties of 1967 and 1968 could be further accentuated by the lack of adequate demand in 1969 during the late stages of System/360. At this reading, I would anticipate the need for a price adjustment in the late third or early fourth quarter 1968.

1970 and Beyond

Except for the distinctly possible rental inventory upset, we have good prospects for continued growth in the longer term. The year 1970, however, is a problem to us in both financial and manufacturing capacity terms. The Strategic Plan will tell us more about our ability to contain.

* * * * * * *

Equipment Sale—The most serious business problem we face is the sharp acceleration of equipment sale. I believe this high rate of sale will continue into and possibly through 1968, and the company should, in my opinion, take several positive actions to correct this severe imbalance of purchase and lease. The maintenance price increase seems to me to be absolutely essential and thoroughly justified. I do not think it is wise that the company would take a nominal increase as against a completely corrective increase as we have recommended. However, if we are forced to the position of a nominal increase, we should immediately set plans for two additional annual increases to correct fully our highly vulnerable cost-to-price condition. Realistic multipliers on all new product announcements are a must, and we possibly may require a price adjustment on some of the high end products such as Model 65 and 75 CPU's, and their associated memories. If we cannot have a purchase price increase, then I believe a rental price reduction may be in order. This is being studied by my people at this time. Further, I believe we need to modify sharply or perhaps eliminate the purchase option. None of these actions is easy or without risk. The consequences of a continuation of our present trends are more serious, in my opinion.

Backlog—This office is somewhat concerned over recent sales records in view of the near term under-scheduled positions which appear chronic, the high cancellation rates, and our inability to achieve unit sales and new accounts in adequate number. There is every indication that the Model 20 is suffering a decline. I will predict that the Model 25 will bring the Model 20 to a stalled position, and I believe that further investment in the Model 20 other than the D program is highly questionable. The key problem here is our ability to create enough demand across the line to sustain the resources we now have. This condition must be monitored on a regular basis and marketing action programs must be implemented to correct the weaknesses.

Information Systems—This is a case of darned if we do, and darned if we don't. Highly advanced new systems may be the only real lever we have over control of this complex data processing business, which has defied subdivision up to this

time. It may be that highly sophisticated and well developed information systems are a good alternative to further divisionalization and splitting of our business. Aside from that factor, systems such as the Manufacturing one and the AAS may be crucial to future operations—getting the job done. These systems are late and the cost is high. They are hard to justify in dollars and cents, but our recent experience in Field Administraiton points out the importance of advance thinking and anticipation of operational problems. In my opinion we should continue at a reasonably fast pace to develop the new systems and we should take all deliberate steps to eliminate marginal systems projects, and certainly all duplicative systems projects. Along this line, I am holding a review of all planning systems to determine the extent of possible duplication and to recommend a coordinated, modified attack which will give us good planning and reasonable information systems economy.

Wage Cost—Convergence of several major corrective programs within a short space of time represents a cause of deep concern on our part that we are driving our expenses and costs up too far, too fast and without the prospect of pricing offsets. We have seen a rapid succession of what I deem to be relatively short fused and uncoordinated responses including the UAW adjustment, the acceleration adjustment, the Exempt Overtime recommendation, and the possible milage allowance modification. Each one of these makes sense by itself. When you put them all together, I believe it is too much, too fast. Some hard-headed business positions should be taken to modify one or more of these programs and bring the aggregate more in line with reality and preserve our cost and expense competitiveness. I recognize the problem of keeping up with the economy and offsetting inflation for our employees. We do not want to do this on such a scale that that we will look back with regret over such rapid fire acceptance of every proposition that the Personnel Department can dream up for the Group. Also on the personnel scene, we recognize the difficult situation we face with regard to key losses. Broad programs of accelerated wages will not solve this problem, in my opinion. Neither will IBM's current stock option program. The answers to this problem are not simple, but I would be thinking along the lines of contracts for key personnel and some kind of arrangements which will provide the possibility of grabbing the "brass ring" if product and market developments are successful.

Product Strategy—The present trend toward customer and third party ownership in the marketplace calls for astute modification of our strategy. Assuming stability of architecuture, we probably need to consider such as the following:

1. A bigger jump in price performance in the next round.
2. Faster and bigger memories.
3. Great function.

Measures of this kind are essential to keep the market moving and growing despite a high level of purchase and cut-rate leasing of current 360 offerings. They are also essential to the maintenance of price level in future products. Every aspect of product introduction needs to be reconsidered, including timing. At the present reading I am not sure we have enough leverage over development management to make these things happen. Decentralized systems management has clear disadvantages here, and while I would not abandon the concept, I think we must be careful to give enough central direction to make sure that important factors are not overlooked in the changing environment. We still face the traditional CPU mentality throughout much of our development area. Is ACS right?? How important is the advance of logic? We have seen recently that the advance of memory technology may be much more important. Business management will have to put out extra effort to keep up with rapidly advancing technology in the immediate future.

Development Programs—In our opinion, the business cannot afford many "TOAKE" programs. Since the problem with that program is variable cost, additional volume leaves us in the bad situation. Along these lines, we strongly recommend that we stop the transaction recorder now, and we believe that it should have been stopped a year ago. The hydraulic printer is a similar example. Further, SBS will not be a successful program as presently constituted, and needs to be sharply modified or terminated. Action to stop the weak programs is necessary if we expect to devote our resources on any kind of an optimized basis toward a maximized ultimate result. There are many good programs around in which to invest our money, and these receive our full support. We would further caution that big programs with serious question marks such as the 27NT should be closely monitored and should not be committed on an absolute basis until the

problems are resolved. Finally, I offer again the position that we are spending too much money on ACS in 1968 and 1969.

Systems Management—There is some turbulence over responsibility and profit management in this area. We are working with the key players in Division and Group Staff to get clarification of responsibilities and appropriate reporting. We will be meeting with both of you soon on this.

/S/ Ted
T. C. PAPES

TCP:AM

PLAINTIFF'S EXHIBIT 112

August 6, 1968
Office of the Controller
DPD HQ
112-5
4460
System/360 Price Increases
Your memorandum of July 31, 1968
Mr. T. A. Spain

IBM Confidential

Tommy, in paragraph 3 of your letter you suggest that it is in IBM's best business interest to increase the level of outright purchase of System/360's. This point of view is in such fundamental disagreement with what I believe to be in the Company's best interests that I suggest we seek to reconcile our different points of view. I would appreciate hearing from you what rationale or support you have for the position that higher levels of purchase are in our best interests.

It is clear to me in the context of the Strategic Plan of the Data Processing Group and for that matter of the IBM Corporation that a reasonable balance of lease and purchase is in our best business interest. The level of purchase we have experienced for the last twelve months is in my opinion totally out of line with this appropriate balance of lease and purchase and is in fact excessive when viewed in context with the long-term growth objectives of the Corporation. If you have any data or rationale that changes this fundamental picture we should make it known to the Group and to the Corporation.

A. J. KROWE

AJK:ls
cc: Mr. J. E. Cuth, Jr.
Mr. D. T. Kearns

PLAINTIFF'S EXHIBIT 267.

IBM Registered Confidential

May 1, 1969

To: Mr. W. C. Hume
Mr. G. E. Jones
Mr. B. Marshall
Mr. M. B. Smith

Subject: DPG 1969–1975 Goals—Financial Critique

Corporate Finance does not agree with the profit margins in the DPG Goals, in that margins are restored too slowly and profit turnaround from 1968 occurs too late.

Highlights

The large purchase bubble between mid-1967 and mid-1969 has advanced significant revenues which would have been received during the Goals period under a more traditional pattern of purchase activity. Although the compound growth rate in revenue and profit between 1968 and 1975 or 1969 and 1975 shows a relatively balanced growth pattern (Revenue growth of 12.7% profit growth of 13.0% from 1969 for example), reflecting a return at the end of the period to a more traditional financial performance level, the annual pattern of revenue and profit shows the heavy impact of the purchase activity (see Exhibit 1). Relatively minor changes to normal expense growth patterns when combined with significant shifts in revenue produce this irregular profit pattern.

The long-term profit degrading effect of purchase can be seen by comparing the profit margin of the aggregate revenues and profits during the period with similar figures for the preceding period:

1968–75:	
Revenue	\$39, 850
Profit	\$10, 680
Percent	26. 8
1960–67:	
Revenue	\$14, 154
Profit	\$4, 181
Percent	29. 5

In addition to the effect of differences in product mix, market and competitive environment, etc., one of the major reasons for this decline in profit levels can be attributed to the continuing service requirement of the purchase sinventory.

Another important facet of this increase in purchase, and another way to view its long-term profit effect, is the distortion of conventional expense to revenue measurements caused by the service requirements of the relatively large purchased inventory. (see below on Expenses)

Finally, this large purchase inventory has the further effects of slowing acceptance of next generation systems and increasing the average yields during the acceptance period. Through a combination of price discounting and special service or programming offerings by third party organizations NS will be prevented from or delayed in replacing a larger portion of the installed inventory. When replacement of a purchased system does occur, especially in the early years of the program, it will most probably replace an installed IBM rental system of smaller point value, thereby producing higher yields (see section below or business volumes).

*   *   *   *   *   *   *

Exhibit 2.—*Report on Market Appraisal, Bendix Computer Division, Bendix Corp.*

APPRAISAL OF THE MARKET FOR THE BENDIX G–20, G–20, AND G–25 COMPUTERS

BENDIX COMPUTER DIVISION BENDIX CORP., LOS ANGELES, CALIF.

(This report is confidential and intended solely for the information of the client to whom it is addressed.)

January 1961

BOOZ · ALLEN & HAMILTON

Management Consultants

CHICAGO · 3

January 6, 1961

Mr. M. W. Horrell, General Manager
Bendix Computer Division
Bendix Corporation
5630 Arbor Vitae Street
Los Angeles, California

Dear Mr. Horrell:

We have completed the work as outlined in our proposal letter of October 18, 1960. To the extent we found it possible to do so, we have answered the five questions set forth therein, and these answers are presented later in this summary report. However, it became apparent early in the study work that the complexity and rapidly changing nature of available computers and the market for them was such as to make it impossible to answer with any real confidence the question of what penetration Bendix can reasonably expect to obtain with the G-20.

Thus, in order that the findings and conclusions we do present may be viewed in their proper perspective, we feel it necessary to precede them with a general discussion of the events that have led to the present situation. The combined effect of these various prior events presents

Bendix with a real need to make some major decisions as to the best future course of action for the computer division. In order to assist in this decision process, certain basic courses of action have been set down and then examined as to their feasibility of accomplishment. These are presented later within this report.

1. BENDIX ENTERED THE COMPUTER FIELD BY SERVING A DISCRETE SECTION OF THE MARKET THAT WAS NOT ADEQUATELY COVERED BY THE IBM PRODUCT LINE

At the time the G-15 was introduced to the market, a significant gap existed in the IBM product line between the IBM 604 punched card calculator and the 650 stored program computer. Several companies, including Bendix, Royal McBee, and Burroughs, recognized the opportunity presented by this gap and introduced small scale, stored program computers. These products met a real need in the engineering-scientific market and attained immediate sales success. An attempt by IBM to counter this threat with the model 610 was not effective.

The problem facing IBM with respect to the introduction of a machine fully competitive with the G-15 class and thus competitive with their own 650 was discussed in our 1957-1958 report. The opportunity presented by this situation was clearly apparent at the time and the recommendations and forecasts presented therein were predicated upon its exploitation. Sales of small scale E&S computers proceeded

generally in accord with the estimates and programs developed at that time up to this past summer when IBM introduced the 1620. This new equipment fills the gap in the IBM line and, in addition, offers many significant advantages over the G-15, placements of which dropped off sharply. This move by IBM, combined with the recent introduction of other small scale computers utilizing the latest solid state circuitry and core memories, such as the Packard Bell 250, Control Data 160, Royal Precision 4000 and the Autonetics Recomp II, will force the G-15 into the last part of its life cycle.

Bendix does not now have a fully competitive computer to offer in this part of the market; the G-20 does not replace or supersede the G-15 with an improved model, but enters an entirely different segment of the market.

2. BENDIX DEVELOPED THE G-20 TO REACH THAT SEGMENT OF THE MARKET LYING WELL ABOVE THE G-15

The G-20, rather than being a small to medium computer that many of your 300 satisfied G-15 users could advance to, is actually in the area of sophisticated computers classed as "medium" in our earlier study. The more elaborate G-20 installations will, in fact, be well within the large scale portion of the market in terms of price and performance.

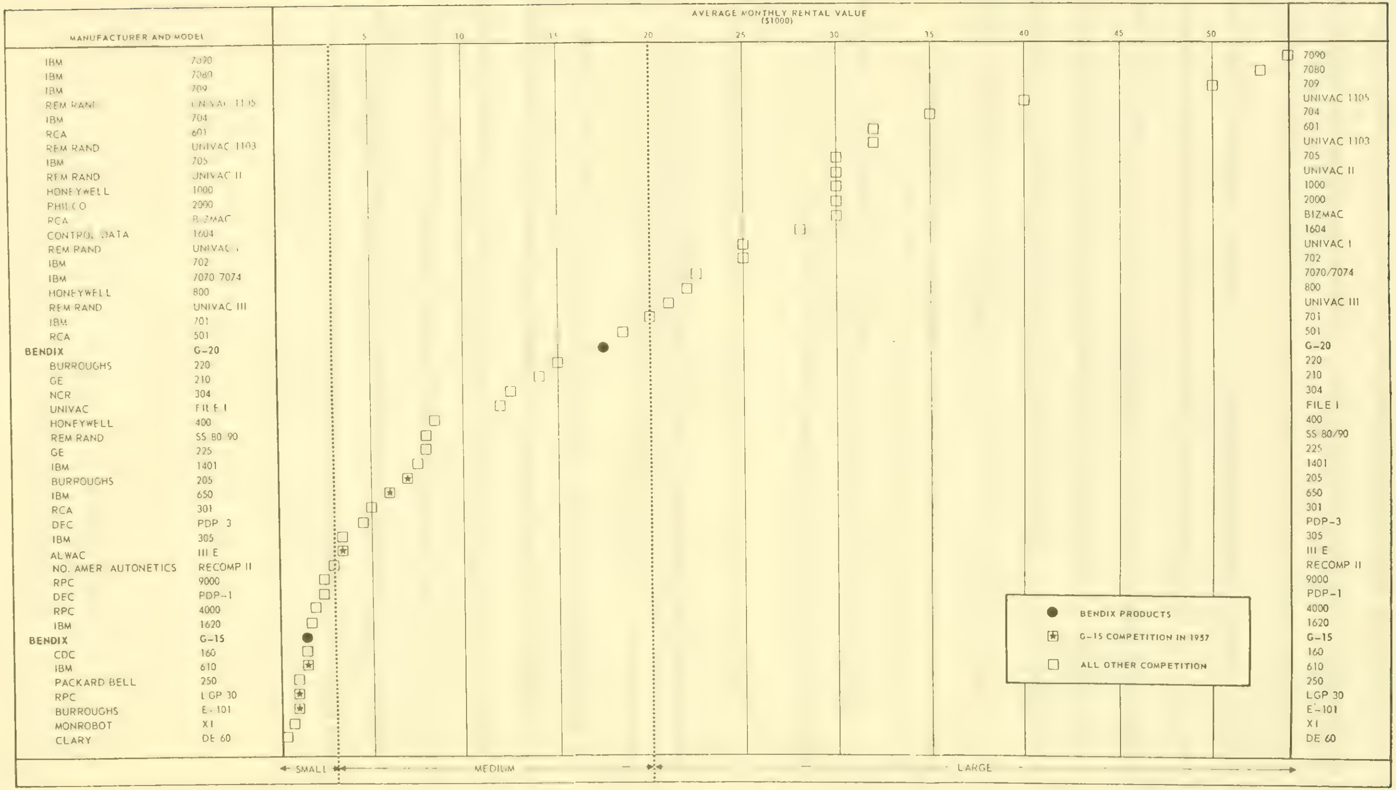
Exhibit I, following this page, shows the relative position of the Bendix G-15 and G-20 with respect to the computers currently in use or available for procurement. The units are listed from top to bottom in order of descending monthly rental for a "typical" system. It can be seen that the G-15 user has the choice of a number of different computers with superior capabilities to the G-15 before reaching the G-20 class system. The significant increase in competition facing Bendix is also shown on this exhibit, in that the division's competitors at the time of our earlier study are shown as squares $\boxed{*}$, while virtually every model shown is now in competition with either the G-15 or G-20.

In its class, the G-20 is a top quality computer offering considerable computational capability per dollar of rental.

The system is generally equivalent to competitive equipments offered by IBM, Remington Rand, Minneapolis-Honeywell, and other manufacturers. As pointed out above, with very few exceptions, it does not provide the G-15 user, who has fully loaded his machine, with an opportunity to trade up to a more capable computer in the Bendix line without increasing his expenditure more than fivefold. The G-15's that have or will soon become saturated will be replaced with the IBM 1620, Recomp II, or similar equipment; the G-20 will have to be leased or sold to new customers entering the market or to replace obsolete

EXHIBIT I
BENDIX CORPORATION

PRODUCT LINE COVERAGE
WITHIN THE COMPUTER MARKET



medium scale installations such as the IBM 650 or Burroughs Datatron 205, or large systems such as the IBM 704 or 709.

3. WHILE THE G-20 WAS UNDER DEVELOPMENT, MAJOR CHANGES WERE TAKING PLACE IN COMPETITIVE PRODUCT LINES

Since 1957, a whole new family of IBM computers has entered the market place. In addition, Remington Rand, Minneapolis-Honeywell, RCA, GE, Control Data Corporation, and others have introduced new systems covering most fields of application.

(1) An Almost Continuous Range of Choice Now Exists; Market Categorization by Large, Medium, and Small Has Lost Much of Its Former Meaning

Along with the new equipment developments that have taken place, such as the transition from tubes to transistors and drums to cores, several other significant changes have taken place in computer design concepts. Through the use of accessory devices and a wide variety of peripheral equipment, the range of applications of a given base unit may be extended over a relatively broad portion of the market. This is true of the G-20 computer, as well as its competitors. As a result of these developments, the relatively clear lines of demarcation that did exist between small, medium, and large computers

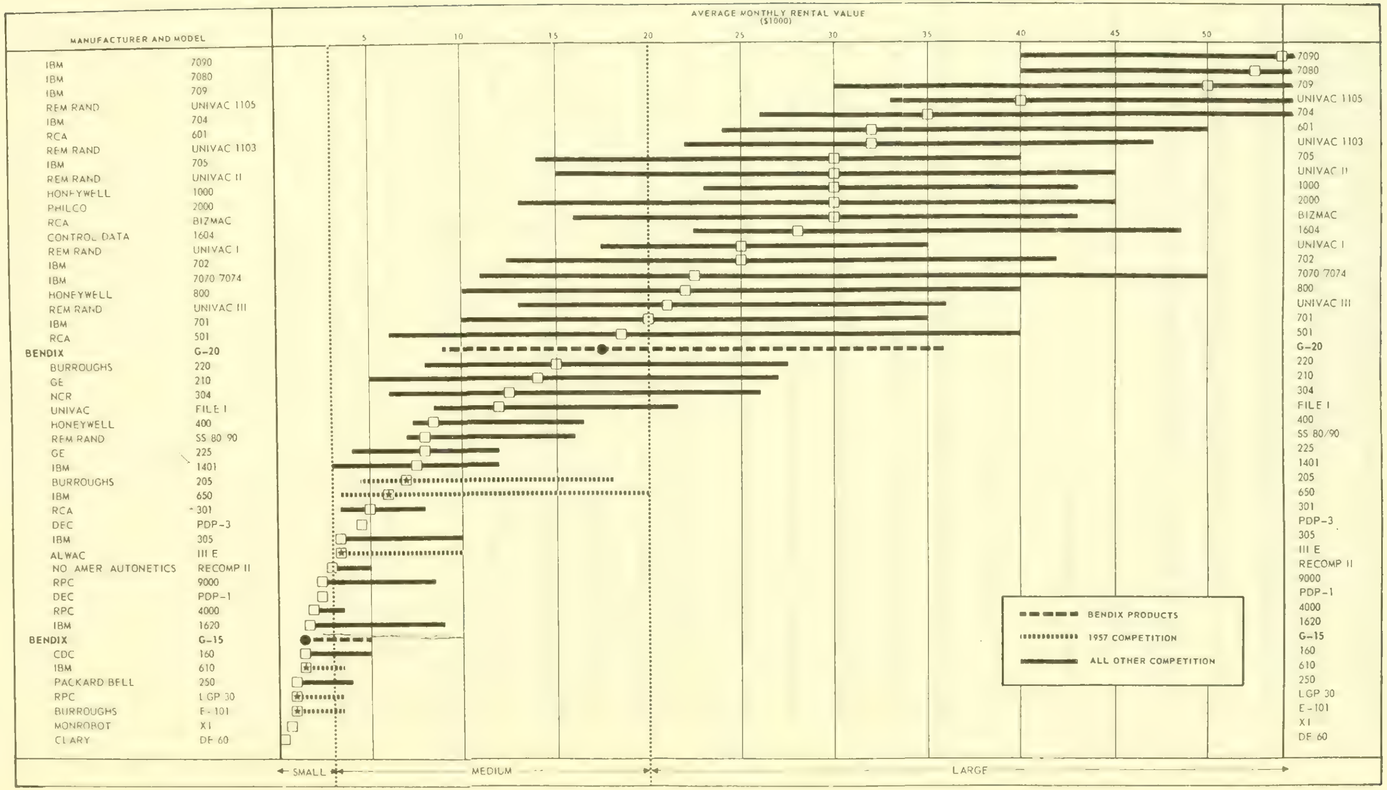
have pretty much disappeared. There is, of course, graduation from the minimum useful equipment obtainable up to the very large and powerful systems, but no longer can any one base unit be said to occupy a specific or somewhat limited portion of the range.

A general idea of the confusion in the market place brought about by these developments can be seen by superimposing the system price range for the minimum useful installation up to the super de luxe model with all of its associated "bells and whistles" on the exhibit shown earlier. This is presented as Exhibit II, following this page. This "modular" blending of equipment offers the prospective user a wide selection among equipments and manufacturers.

(2) There Is No Longer a Major Distinction between "Engineering-scientific" Equipment and Business Data Processing Equipment

Of special significance to Bendix is the merging of "engineering-scientific" and "data processing" equipments into one as a result of advances in technology, computer design practices, programming techniques, and the requirements of the customer. Various systems have been slanted toward the engineering or data processing markets through the selection

EXHIBIT II
BENDIX CORPORATION
COMPUTER SYSTEM PRICE RANGES



of design alternatives during the development process or through the orientation of the marketing effort. Both methods have been used in an effort to "optimize" the Bendix G-20 for the engineering market. It is important to note, though, that all manufacturers are increasing the number and type of accessories available to their equipment in order to satisfy as large a segment of the market as possible.

This change did not come about by pure happenstance; it meets a real and growing demand in the market place. In technical research centers, for example, many of the calculations now required to solve technical problems are of a data processing nature, requiring the handling of large quantities of input and output with relatively simple computations. Thus, the scientist needs certain data processing capabilities in his computer. Similarly, as more information becomes available to corporate management through the use of automatic data processing equipment, growing uses are being made of various operations research techniques drawn from the fields of science and mathematics. The solution of these problems requires many of the same computational capabilities previously considered necessary only for scientific computers.

Another factor calling for equipment equally adept at scientific or data processing work is an essentially economic one. Generally speaking, the cost per unit solution declines as the size and capacity of the newer computer systems increases, making it more imperative than ever that a single installation be used by the accounting and clerical areas of the business and also by the engineers and scientists.

Finally, if two equipments are needed in companies with really great capacity requirements or in those instances where the scientific and clerical functions cannot share equipment for some reason, it is advantageous to have their computers identical or at least fully compatible, so that, in case of breakdown, vital work can be quickly transferred to the other machine.

Thus, the opportunity for uniqueness and specialization in the "engineering-scientific" area, seemingly a major point in Bendix policy, seems to no longer exist, at least so far as equipment design is concerned. Of course, it can still exist in the orientation of the sales and support effort, if such a course is feasible.

4. <u>THUS, WITH A SINGLE MODERN-DESIGN COMPUTER, BENDIX NOW FACES HEAD-ON COMPETITION WITH IBM, REMINGTON RAND, RCA, MINNEAPOLIS-HONEYWELL, GE, AND OTHERS - EACH OF WHICH HAS A BROAD PRODUCT LINE AND, IN THE CASE OF IBM, A LINE WHICH BLANKETS THE FIELD</u>

It is evident that the unique position in a discrete section of the market held by Bendix only a few years ago has completely disappeared. The conditions under which, in spite of its relatively small size and limited sales effort, the Bendix Computer Division competed successfully in the computer business no longer exist. This is partially because the giants of the industry were not actively competing for the small computer market until recently and partially because of changes in the characteristics of the market discussed above.

The G-20 appears to us to be an excellent computer, fully competitive so far as its technical excellence is concerned; yet it is not unique in this respect - other equipments are just as good or even better for some applications. Neither does it, to any significant or lasting degree, enjoy a price advantage or suffer any price disadvantage. We say to a "lasting degree," because it appears probable that the current price-performance disparity between the new generation equipment and its predecessors will be largely eliminated through price adjustments, discounting, and lease concessions.

Thus, the factors which govern the probable market penetration of the Bendix G-20 are totally aside from the equipment itself; they have to do with the Bendix image in the computer market, the magnitude and direction of its sales effort, and the service offered both as to the maintenance of equipment and the availability of programming services.

5. BENDIX IS NOW FACED WITH THE NEED TO REACH A MAJOR DECISION WITH RESPECT TO THE BEST FUTURE COURSE OF ACTION FOR THE COMPUTER DIVISION

With these significant changes in the nature of the computer business and the relative position of Bendix in it in mind, management is appraising its probable future position in order to arrive at a decision as to the best course of action for the division. In approaching such an appraisal, it seems realistic to consider Bendix as having developed a technically acceptable product (the G-20) and it is now trying for the first time to break into a business or market characterized by five features of major importance and pertinence.

The realism of this approach is not significantly altered by the fact that Bendix has been in the computer business and has established an excellent reputation with the G-15. The image so created is one of participation in a small and special portion of the market, which only slightly improves its position over a total newcomer attempting to enter the computer business on a broad scale. Likewise, the division's sales force has had limited prior experience. Those who played the most active part in the G-15 sales effort are now, for the most part, in administrative positions rather than active selling. The newer members of the organization will require a year or more to gain the experience and knowledge necessary to become equally productive.

The five features considered to be of major importance and pertinence are:

(1) The Market Is Tremendous.

(2) The Competition Is from Real Industrial Giants.

(3) There Is No Really Significant Product Advantage Held by Any Manufacturer.

(4) The Product Is Expensive - Thus, Its Purchase Receives Top Management Attention.

(5) It Is a High-investment Business in Which No Profit Is Returned until the Equipment Has Been on Lease for More Than Four Years.

Each of these features is discussed in detail below.

(1) <u>The Market Is Tremendous</u>

There is hardly any question that the opportunities for worthwhile computer installations are so great that the total size of the market can accommodate on a profitable basis a considerable number of competitors if it were equally divided. Exhibit III, following this page, reflects the annual rental revenue that has been and probably will be derived from this market between 1955 and 1965. Ten companies could each derive over $100 million in revenue apiece in 1965, if the market were evenly split. Unfortunately, this is not the case, for

IBM has held, and will probably continue to hold, at least a 70% share, while the second largest contender, Remington Rand, holds an additional 18%.

Thus, statistics on total market size are not of much significance in appraising the Bendix problem. What is important is the probable size of the market after IBM and the second place contender take their portion. Since this portion will almost certainly be 85% or more of the market, the revenue remaining for all others will probably range between $70 million today and $165 million in 1965. Therefore, it would appear that the more significant question becomes "what is the minimum size and revenue needed for profitable operation, in view of the extensive product development effort and relatively high sales expense required to participate in this industry?"

(2) The Competition Is from Real Industrial Giants

Of course, as discussed above and shown on Exhibit III, IBM is the major competitor in this industry, with a historical share of more than 70% of the total market. In the segments where IBM has concentrated product and marketing effort, its share has been closer to 80%. Even in the one identifiable instance where competition had a significant jump on IBM,

bank automation, the company has captured no less than 50% to date. Thus, the significance of the fact that Bendix achieved its success with the G-15 at a time when IBM did not have a competitive product becomes even greater. It is also important to note that Bendix's share, though 35% of the small computer market, represents only a little more than 1% of the total.

Comparatively recently, such companies as RCA, Minneapolis-Honeywell, GE, and others have entered the computer field with a major effort. Each has already spent large sums, upward of $50 million in product and market development, and appears willing and able to continue a high rate of expenditure to carve out and maintain a position. Furthermore, all this effort on the part of these relative newcomers is economically justifiable only on the basis of profits five to ten years away. In other words, their current expenditures are investments on a long-term basis to establish a position from which profits can be earned at some time in the future. Each of these companies has other profitable and related product lines to support the development of both equipment and markets in the computer business.

It would seem that, to be successful in the face of this type of competition, a major effort is essential, as well as a

willingness to expand aggressively, even though it means foregoing current profits. The computer business is one in which large size is essential to success and this means large size in the computer business.

The only possible alternative would be to find a field of specialization both as to product and market and establish in it a preference for Bendix equipment. This seems to be what Bendix would like to do if it is at all possible.

(3) There Is No Really Significant Product Advantage Held by Any Manufacturer

The evidence is now strong that there is no essential difference in an "engineering-scientific" computer and a "business data processor." As previously pointed out, real data processing capacity is a requirement for many engineering-scientific installations, and the total cost of the more sophisticated equipments is such that the incremental construction cost of a dual purpose unit is relatively small. In addition, the customer often requires multiple usage to economically justify the investment. Thus, by and large, there are now just computers - not E&S computers and data processing computers.

At present, some relatively small differences do exist in the details of operating features, physical design, et cetera,

which can combine to give a lower cost per unit of work for a particular application or user than some other possible combination. However, viewed in the sense of the broad problem now faced, not only by Bendix, but by all computer manufacturers, these differences are not now, nor are they likely to become, such that they provide any one manufacturer with a lasting product advantage of any significance in the market place.

The hardware appraisal conducted by the study team in cooperation with the Bendix marketing department clearly shows that the Bendix G-20 has no product advantage sufficient to markedly influence its penetration of the market. Some features, though ahead of the field at this moment, will undoubtedly be matched or even surpassed by competition in the very near future.

(4) The Product Is Expensive - Thus, Its Purchase Receives Top Management Attention

The lease or purchase of a modern medium or large scale computer represents an undertaking of sufficient importance to receive top management attention in most if not all cases. This was not always the case with the G-15, since the smaller expenditure (around $18, 000 a year) represented by this equipment could

often be authorized by the user himself or middle management. In the case of the medium and large systems, there is much more involved than merely the rental cost, which averages $120, 000 and can easily run to more than one third of a million dollars a year. The use to which the computer is to be put can also involve significant additional expenditures for site preparation, installation, and programming, to say nothing of the major disruptions and changes in organization and procedures that often accompany a computer installation, especially if it is for data processing use.

Under these circumstances, decisions as to equipment selection tend to be made by executives who are not too conversant with detailed operating features, but who will place considerable weight on the experience, reputation, and substantiality of the computer manufacturer. In this respect, it can hardly be argued that IBM does not hold a distinct advantage at the moment, because of its well-established image in the field. This outstanding image stems from several important factors. First, some 80% of the installed medium and large scale systems are IBM products. A number of the more knowledgeable users were contacted during the course of our assignment. We found virtually all of them to be satisfied

with the quality of IBM products and service. Although most were sophisticated enough to recognize that an IBM system was not necessarily the best in its class, they did indicate that IBM would have to slip quite drastically in their sales and service support (which they considered unlikely) or that a competitive system would have to do much more for less money than its IBM counterpart (also considered unlikely), before they would change suppliers.

The second source of IBM's established image stems from the more than 90% share it holds of the electrical accounting machine (punched card processing equipment) market, since the users of this equipment today will, for the most part, be the new computer users tomorrow. "Brand loyalty" among this group of potential users, as well as among the current users of IBM equipment, will, from all indications, tend to perpetuate its dominant position in the market.

This position of distinction can, in all probability, be overcome in the long-term future, if effort of adequate quality and magnitude is applied; RCA, GE, Minneapolis-Honeywell, and others are making a concerted (and, we might add, very

costly) effort and are making some headway. The extent to which these efforts will ultimately be successful is conjectural. IBM's volume and position in the market permit them to employ a number of countermoves that are not available to their competition, including large rental concessions, free programming and conversion, used computers at substantial discounts, and last, but by no means least, the shelter of a very substantial profit margin.

In any event, to the extent that other competitors are successful, it will be even more difficult for Bendix to establish an equivalent image in the buyer's mind and a significant place in the market.

(5) It Is a High-investment Business in Which No Profit Is Returned until the Equipment Has Been on Lease for More than Four Years

One of the most important features of the computer business is its lease orientation. The importance of this and its effect upon the product line development and marketing processes were discussed in our 1957-1958 report. It is of sufficient importance to warrant repetition here.

It is not enough to simply lease and install a computer. Once installed, it must, if at all possible, be kept in place until the investment represented by it is returned and a profit obtained. Furthermore, if the manufacturer is going to remain in the computer business, he must be prepared to replace the equipment with another system which can handle the increased work load or provide the additional capabilities required by the user.

Based upon the present rate of new product introduction and current industry pricing policies, this cycle takes a little more than four years. If the installed equipment is returned to the manufacturer in less than four years because of competitive pressures or a change in the user's requirements, the manufacturer is either faced with a direct loss, or the need to "re-lease" the unit, at least doubling the marketing cost for that unit and further deferring the break-even point.

Thus, the successful (and by this we mean profitable) computer manufacturer must constantly follow a strategy of well-planned product development and carry out a closely coordinated marketing program. This strategy must be sensitive to two distinct pressures: competitive and the needs of the users.

Equipment with a competitive technological advantage may be successfully marketed on the basis of this advantage until it is equalled or surpassed by one or more competitors. Once it is surpassed, the market is further divided and the units already installed come under increasing pressure from technological or economic obsolescence. In a market where the product is sold rather than leased, the loss due to obsolescence usually falls to the buyer - in this market, it falls to the supplier.

The second source of pressure upon the manufacturer stems from the almost constantly changing requirements of the user. Computer usage expands both horizontally and vertically. Horizontally, in that a large portion of the scientific users are moving into data processing-type problems. Similarly, machines previously used only for business data processing are being increasingly employed for the solution of scientific problems or complex business problems that require extensive computation.

Vertical expansion occurs as a particular user approaches machine saturation in the course of solving ever-increasing numbers and types of problems. Pressure then mounts to expand the capacity of the present system or replace it with a unit that is more closely geared to the changed requirements. Most

users would prefer to move up within the product lines of their present suppliers, if their prior experience has been satisfactory, since it generally minimizes reprogramming, media conversion, and changes in standing relationships between buyer and supplier.

The net effect of these pressures toward vertical and horizontal product line expansion is increased by the lease orientation of the business. If a manufacturer fails to offer capable equipment in all application areas, one or more competitors will use this as a wedge to drive out his equipment and replace it with their own. Bendix did this with the G-15 when IBM failed to provide the IBM 604 scientific user with a suitable computer. Likewise, the superior data processing capability of the IBM 1620 will undoubtedly force a number of G-15's out of the market. Similarly, the successful manufacturer must also offer larger equipment, so that his users may grow within his line - not shift to a competitor. The problems facing Bendix with respect to the G-15 were discussed earlier. Likewise, similar pressures will eventually come to bear on the G-20. We do not believe that the problem of vertical product line expansion can be avoided, for it is one of the basic characteristics of the market. The manufacturer who does not offer a full product line will, in all probability, be forced out of the market by those that do.

The above provides a brief, but succinct, description of the computer business or market and the current Bendix position. Given this situation, then, what is the best future course of action for the computer division?

6. THERE ARE FIVE MAJOR COURSES OF ACTION TO BE CONSIDERED

It seems fairly apparent that Bendix must choose, in the main, from these five alternative courses of action:

(1) Concentrate on selling to technical centers for engineering-scientific applications, which may include some subsidiary data processing applications.

(2) Expand into serving the computer market in all its facets, that is, selling in all markets for either data processing, engineering-scientific, or combined applications.

(3) Endeavor to participate in the market on a limited scale, exploiting small, profitable segments of the market wherever they might develop.

(4) Redirect the efforts of the computer division to some market other than general purpose digital computer systems.

(5) Withdraw from the computer business and dispose of or liquidate the computer division.

The fifth possible course of action is presented at this point in the discussion only in the interest of completeness. It should be held in the background to receive serious consideration only if success cannot be

foreseen as a result of any of the four positive approaches. Should it finally appear to be the course to follow, considerable work would be needed to develop the details so as not to impair Bendix's position in other present or future markets.

The first three alternative courses of action are purposefully phrased in terms of marketing. As previously pointed out, such differences that may exist between medium to large scale data processors and scientific computers are relatively unimportant. Certainly, they are not such that their effect upon the nature, magnitude, or cost of the required research and development program would be significant in selecting the correct course of action for Bendix. In either case, the dimensions of the R&D effort will be governed by the extensiveness of the product line and its associated peripheral equipment. To the extent that more accessories and programming support are called for in the various data processing application areas, it would require more engineering and systems support effort than would be the case if sales were limited to the purely scientific portion of the market. This extra work can hardly be a policy determinant at this time.

The question is not, can Bendix design and make computers; it is, can it lease or sell them in sufficient quantities to be profitable? Some insight into the answer to this question is provided in the next three sections.

7. <u>IT IS UNLIKELY THAT BENDIX CAN OPERATE ON A PROFITABLE BASIS SERVING ONLY THE ENGINEERING-SCIENTIFIC MARKET</u>

An internal study conducted by the computer division in the spring of 1960 indicated that annual placement of twenty-four G-20's and one hundred and two G-15's or the equivalent is required for a profitable operation. This study is now almost a year old and may well be subject to question as to some of its details; nevertheless, it does provide a frame of reference against which to view Bendix sales prospects.

It appears to us unlikely - in fact, almost impossible - for Bendix to achieve this volume if it concentrates on selling to technical centers for engineering-scientific applications, even with such incidental carry-over into data processing applications that would occur. Our reasons are:

(1) <u>To Place Twenty-four G-20's Would Require Bendix To Capture 90% of the Market after IBM and Its Closest Rival Had Taken Their Probable Share</u>

Our study, as detailed in Appendix B, indicates that approximately 750 computer systems in the G-20 category will enter the market for essentially engineering-scientific use. Of these, some 450 will be net additions to the existing population, while an additional 300 will be replacements for presently installed equipment.

Within the new market, IBM and Remington Rand (or its successor as second place contender) can be expected to get at least 80% of the 450 units, leaving approximately 90 for all other competitors. Within the replacement market, IBM may be expected to obtain approximately 85%, since most of the units to be replaced are IBM products. This leaves an additional 45 units for all other suppliers. Thus, the total market available to Bendix and as many as eight other competitors is in the vicinity of 135 units, over the next five years. This total is 15 units more than Bendix feels it needs for profitable operation. Furthermore, Remington Rand, RCA, Minneapolis-Honeywell, GE,Control Data Corporation, and possibly others are going after this business at least as aggressively as Bendix.

It seems obvious that, if these figures are anywhere near correct, it is virtually impossible for Bendix to meet its G-20 volume needs under this restrictive course of action.

With regard to the correctness of the figures, it should be pointed out that complete and precise data, even on the history of this market is hard to come by. Furthermore, the market itself is definitely in an unsettled period where neither the consumer nor the manufacturer is very certain as to what will happen

next. In order to cross-check our forecasts, two completely different methods were employed. The basic approach was the same as that used in our 1957-1958 study and was based upon historical and probable future expenditures per engineer and scientist for computers. This estimate was verified by a correlation analysis and projection based upon federal expenditures for research and development. These two forecasts fall within an 8% range of estimate. These estimates are further detailed in Appendix B.

The one prime source of possible error is in the assignment of 80% of the new market to IBM and one other manufacturer. Historically, IBM and Remington Rand have accounted for 85% or more of the medium computer market and some 96% of the large systems. Likewise, the assignment of an 85% share of the replacement market to IBM may be subject to question (though it was borne out during the field interview phase of our assignment). Even if we assume that Remington Rand suddenly withdrew from the market and IBM only obtained 50% of the new and replacement markets, this still leaves only 375 units for all other competitors, of which Bendix would have to get 32%. We do not believe that our estimates are this far off, but even if they were, it is unlikely that Bendix can, with the sales effort

contemplated in the aforementioned profit analysis, obtain a 32% share with a single modern computer against the other competitors. With a greatly increased sales effort, it is conceivable that Bendix might achieve this penetration, but at the same time, the increased sales expense would move it into an unprofitable operation.

(2) The Market Will Absorb Approximately 2,000 Small Computers during the Next Five Years; Less Than 75 of These Will Be Bendix G-15's

Analysis of recent market trends and their probable effect on future new money entering the market leads us to believe that approximately 1,200 units will be added to the current small scientific computer population by 1965. In addition, approximately 800 units will enter the market as replacements for currently installed computers and punched card calculators that have reached economic or technological obsolescence.

Although Bendix has placed approximately 35% of the small computers currently in use, it seems unlikely that this performance will carry into the future. The introduction of the IBM 1620 second generation computer, will have a much more significant impact upon the market opportunities for the G-15 than did the IBM 610 three years ago. This newer machine

offers considerably more capability than the 610 and fits the IBM product line much better, which will enhance the opportunity for systems sales. Other new computers that have or soon will enter the market will also tend to reduce the G-15 market opportunity. As shown in the comparative evaluation of the G-15 and its current competition in Appendix C, the net effect of this changed product mix and the superior features of the newer equipment will be to subject the G-15 to increasing pressure from technical and economic obsolescence as time goes on.

It is likely that the Bendix share of the unit market will fall from its past 35% share to somewhere in the vicinity of 10%, for the reasons stated above. This, then, offers the division a potential of around 120 units. Some of these would be to new users who want a computer installed quickly, others to prospects who wish to benefit from Bendix's extensive program library and to current G-15 users who wish to add more capacity that is compatible with their existing equipment.

While these 1, 200 units are entering the market to fulfill new requirements, approximately 800 additional units will be procured to replace existing installations. Since the G-15 will

be under pressure from obsolescence itself, we do not believe that it will participate in the replacement market - except as a candidate for replacement.

In the opinion of your sales people, approximately 50% or some 160 of the currently installed G-15's will approach usage saturation in the next 12 to 18 months. In this event, it is probable that a large portion of these units will be turned back and more powerful equipment procured. As these G-15's are returned, they will become available for re-lease to new customers, or will be disposed of in some other way such as outright sale at an attractive price.

Since at least a portion of the 120 unit new sales that we see can be met with returned units, the number to be manufactured is less than 120, probably between 50 and 75. This is far below the 350 or so that our earlier study indicated could be installed in 1961 through 1965. It is also far below the 500 small G-15 type computers called for in the Bendix plan discussed above in regard to the G-20. The reduction from our original 350 estimate is in part due to a reduction in the number of small computers that we believe the market will absorb, some 2,400 to 2,800 rather than around 3,300 as seen in late 1957.

The primary cause of the reduction in Bendix's probable share of the market from around 350 to approximately 75, however, is due to the introduction of considerably more aggressive competition and better equipment to this market.

As in the case of the G-20, the quantitative data used above may be off by a wide margin. Any probable variation, however, can hardly change the main conclusion. The G-15 is going to decline in number of net placements at a rapid rate. There is no chance whatsoever of its producing the volume needed for profitable operation in this business.

The G-20, while medium in size as computers go, is nevertheless a fairly expensive piece of equipment. The G-15, as we have shown, is definitely on the down side of its life cycle. The requirements for profitable volume from the engineering-scientific market simply cannot be met with these two equipments.

(3) The G-25 Would Provide the Best Market Opportunity for Bendix at This Time, but It Is Unlikely To Completely Offset the Volume Deficiencies of the G-15 and G-20

There is a definite market for a computer of smaller size than the G-20 and more up-to-date than the G-15. This is being met by IBM with the 1620 and 1410, RCA with the 301, by the

NCR 315, Packard-Bell 250, Royal Precision 4000 and 9000, North American Autonetics, Recomp II and III, Control Data 160, and others.

Bendix does not now have a competitive computer to offer to this market. We have been told by division management that a system in this category could be announced in January of 1961 and initial deliveries made in early 1962. Thus, this product must also be examined in order to determine its contribution to the Bendix program.

The G-25, as now planned, would fall on or very near the hypothetical price line between small and medium class computer systems. Since we have no historical data with which to work in this price class, it appears best to appraise the market for the G-25 in terms of the small and medium markets. If we assume that such a computer can compete for the top half of the "small" equipment market and the bottom half of the medium category, the potential would be approximately 825 new units and 550 replacements over the next five years.

If Bendix were able to capture 25% of the new equipment market, replace 200 of the installed G-15's, and obtain 25% of the remaining 350 unit replacement market, the G-25 potential

would be around 500 units. We would consider this to be the upper limit, based upon a threefold increase in sales and sales support effort which, as in the case of the G-20, would raise the marketing costs to a point where the program might not continue to be profitable.

It is more probable that Bendix's share of this market will fall considerably short of this 500-unit upper limit. We say this for four principal reasons:

- The amount and caliber of competition has increased more than fourfold since Bendix achieved a 35% share of the small computer market.
- Bendix is almost a year behind competition in the introduction and marketing of a computer in this class.
- The marketing force required to achieve this volume will take a considerable period of time to develop; in the meantime, sales will be lost to competition.
- During the period that the necessary marketing force is being developed, the existing small sales force will be further split, reducing its over-all effectiveness in the sale of G-25's and G-20's.

The net conclusion here is that Bendix's market opportunities within the engineering and scientific field are limited by two key factors.

The amount and caliber of competition for each segment of the market is such as to make it extremely unlikely that Bendix can obtain the volume of business necessary for profitable operation.

A marketing force of sufficient size and quality to obtain a profitable share of these markets has not been developed in advance of the current need, and it is unlikely, if not impossible, that one can be formed in time to seriously affect the outcome. Furthermore, even if it could be, the cost of doing so would reduce the already slim chances for a profit in this market.

It will be of interest to you to know that we hold the same opinion with respect to other companies in the field; we do not believe that any company can be successful limiting its attention to engineering and scientific applications.

Thus, we can conclude that Bendix should expand its operations into serving the data processing field, assume the role of a maverick in the computer business, change the nature of the division, or withdraw from the field.

The next point examines the chances of success for Bendix under an expanded operation.

8. EXPANSION BY BENDIX INTO SERVING THE COMPUTER MARKET IN ALL FACETS IS NOT WARRANTED BY THE PROBABILITY OF SUCCESS

We consider it a fair and reasonable presumption that, in addition to IBM, there are other companies who will survive in the computer business and end up with a profitable operation, at least when viewed on a current basis.

The determining factors as to how many and which these companies might be are:

- Size of the total market and how much of it IBM and its nearest competitor are likely to get.
- The minimum size that any one company must achieve to permit a profitable operation.
- Which companies are able and willing to put forth and finance the effort required at the necessary rate.

An examination of these factors from the Bendix point of view can yield some appreciation of the magnitude of effort that would be needed and the sizable risk involved.

(1) The Total Market for Computers of All Types Will Run around $4 Billion over the Next Five Years, with IBM and One Other Company Obtaining 85% of It

On a basis of selling price, rather than rental income, this figure of approximately $4 billion, covering all computers

regardless of size or use, appears reasonable as a starting point from which to examine the opportunity the market holds for Bendix.

If we then allocate 85% to IBM and one other company, this leaves \$600 million, or \$120 million per year, for all others in the field. For comparative purposes, this is the rough equivalent in dollars of about 120 to 160 G-20's per year. Actually, it will be made up of all types of computers, with around 70% or 350 in total being roughly comparable to the G-20 in size. This \$120 million in annual sales will have to meet the needs of all but the two largest companies in the field. Even so, this looks like a substantial market and it is, but as previously mentioned, high sales volume seems to be a prerequisite to success in this business.

(2) A \$50 Million to \$75 Million Annual Sales Volume Appears To Be Required for Continued Success

While the minimum size for profitable operation is conjectural, five key points stand out which substantiate the contention that large size is a necessity.

1. <u>Research and Development Expenses Are High</u>

It is our understanding, for example, that the Bendix development cost for the G-20 will be in the vicinity of $2.3 million. This is only for a single product to compete in this equipment generation. Past history indicates that we may expect the introduction of a new generation of computers every four or five years, at least for as long as the market remains highly competitive. This cycle may lengthen as the art matures, and the degree of difference exemplified by the move from tubes to transistors may never occur again; nevertheless, there will be change and this change will require heavy R&D expenditures to remain competitive. We estimate that it will require from $3 million to $5 million per year simply to maintain an adequate, though not necessarily full, line of equipment up to date. For comparison, IBM reportedly spent close to $75 million for computer R&D last year, while Minneapolis-Honeywell, a relative newcomer, spent an estimated $7 million.

2. <u>Marketing in the Computer Field Is a Very Expensive Undertaking</u>

This is especially true in the data processing application area, for usually a complex system is involved and a great deal of direct selling effort and systems or application engineering work has to be done to convert a prospect into a customer. This sales effort must be directed to a number of "prospects" for each customer that actually signs a lease or purchase agreement. (This ratio has been conservatively estimated at 15 to 1, with even the most efficient sales organization.) A relatively complex systems analysis and detailed proposal must be developed for each of these prospects; all to obtain one "sale."

Furthermore, if it were possible to identify the <u>one</u> best prospect, it is still a long-range necessity to submit a full proposal to the majority of the other potential customers if the manufacturer wishes to continue to be considered for possible future procurement. This total effort requires a large, aggressive, well-qualified, and well-trained direct sales organization.

3. The Direct Sales Force Must Be Backed by a Large and Highly Capable Applications Engineering Force

This part of the organization is charged with the responsibility for developing basic programs, proposals, and system "software" packages for potential and actual customers alike. Since the smaller company must exert a total marketing effort as large and effective as all but its largest competitor, yet write these costs off against a relatively low volume of business, marketing costs will be higher percentagewise for the second, third, fourth, . . . ranking companies. The theory that the smaller company can obtain more sales per dollar of marketing effort by careful prospect selection is fine - except that RCA, GE, Honeywell, and others are employing it also. Thus, in any given situation, Bendix, or any other competitor for that matter, must expect to face extremely strong competition, the pace being set by IBM or its nearest competitor.

4. Systems Service Costs Are High

Prompt service is a must in the computer business. Bendix has established an excellent reputation in this respect, but the cost has been extremely high. Here again, size is a requirement for economy. Enough equipment must be out on lease to make economical use of a minimum size service organization. This is not too difficult in the case of medium and large systems, since a service man usually stays with the equipment. It is a problem with small computers, for geographical concentration is required.

5. Machine Population Affects the User's Choice of Equipment

Size also plays a significant part in the customer's ultimate equipment selection. Few computer users are willing to run the risks associated with having the only computer of its kind in an area. Equipment failure can be a serious problem to the user and his only insurance is the immediate availability of another machine that can handle his work load. RCA, Honeywell, and GE have begun the creation of service center networks in an effort to offset IBM's advantage in respect to machine population. This is also a very costly undertaking.

These points are presented in a semiquantitative manner because of the lack of detailed cost information; however, they do indicate the nature of the problem and provide some measure of the size required to compete effectively in this business.

It seems reasonable to expect that a sales volume of $50 million to $75 million would be needed to provide the necessary sales and service organization, research and development, and missionary work in this field.

If this is the case, the $120 million annual sales volume remaining for other than the first two in the field provides room for only one or two additional companies.

(3) More Strong and Determined Companies Are After a Place in the Computer Business than There Is Room for

The reasoning of the last two points indicates that in addition to IBM there is room for only two or three other companies on a profitable basis.

Currently, the competitors for these two or three positions are:

- Sperry Rand - Univac Division
- Radio Corporation of America
- General Electric Co.
- National Cash Register Co.
- Minneapolis-Honeywell Regulator Co.
- Burroughs Corp.
- Philco Corp.
- Bendix Corp.
- Royal Precision Corporation
- North American Aviation, Inc. - Autonetics Division
- Control Data Corporation
- Digital Equipment Corporation
- El-tronics Inc.
- Monroe Calculating Machine Company
- Packard-Bell Electronics Corp.
- Thompson Ramo Wooldridge Inc.

and possibly others, almost all of which are knowledgeable, well-financed firms with an avowed purpose of making a permanent place for themselves in the computer business. In our opinion, all but three or four will fail to do so, but the economic pressures and profitless sales volume that will result from their attempts will be very costly to all concerned.

In two to five years, after the present competitive situation has shaken down, at least two and maybe more, in addition to IBM, will find a position in the field. The chances are that they will come from the top of the above list.

It is by no means impossible for Bendix to join the race and be one of the winners, but we do think it improbable and feel even more strongly that the chance of success is not worth the risk involved.

If it is agreed that the first two possible alternatives, concentration on the engineering and scientific market and expansion into the total market in all its facets, are not feasible, the third "marketing-oriented" approach should be examined.

9. IT DOES NOT APPEAR FEASIBLE FOR A MAJOR CORPORATION TO PARTICIPATE IN THE COMPUTER BUSINESS ON A LIMITED SCALE

It is well known that there are many instances in industry where a small company may compete effectively and on a profitable basis with the giants that dominate the market. An examination of the general characteristics of such a maverick and specifically the relationships between these characteristics and the computer business is pertinent to Bendix's problem.

(1) It Appears Unlikely That a Small Manufacturer Can Hold a Lasting Position in This Industry

Ordinarily, the manufacturer who assumes the role of maverick in an industry achieves success through one or more of the following routes:

- Lower total costs
- Higher quality or technologically superior products
- Geographical, industrial, or product specialization

These market opportunities and the likelihood of their occurrence in the computer business are considered in the following points.

1. It Is Improbable That the Small Supplier Can Achieve Lower Total Costs

The high cost of the sales, support, and service effort required in this business was discussed in detail above. Essentially, it costs the computer manufacturer the same to develop a computer program such as the

Bendix SPACE, PAR, or SNAP systems for one unit or one hundred. The unit cost is obviously lower with higher volume and is generally reflected in the price to the customer. The same is essentially true with respect to product development and sales and service costs.

Thus, the one prime price reduction opportunity available to the maverick computer manufacturer is in production costs. In this industry, the cost of goods is around 25% of the selling price; therefore, a 20% reduction in manufacturing costs would represent a 5% reduction in the price to be used at best. This is not of enough significance to give the small supplier a lasting competitive advantage, since the dominant suppliers can easily meet it through volume economies in all other areas.

2. <u>It Is Unlikely That the Small Supplier Can Maintain a Significant Degree of Technological Product Superiority</u>

The maverick supplier is usually successful in those industries that have largely achieved technological stability and where the pace of product evolution has slowed considerably. The maverick then exploits the scientific principles and techniques that have been developed in the universities and large corporate laboratories, in an effort to offer a better product without the expense of extensive R&D facilities or a large technical staff. Examples of this approach may be found in the fractional horsepower motor, steel fabrication, paper products, and automotive replacement parts businesses, as well as in many others.

In the computer industry, the state of the art is far from maturity - the rapid pace in technology forces the manufacturer - large or small - to keep abreast, and if possible, to stay ahead of developments in order to maintain product superiority. The $3 million to $5 million annual R&D expenditure cited earlier represents the minimum that we consider necessary to maintain an adequate and up-to-date line of products in this field.

If the small manufacturer does not offer a full line, the product he does offer must be very superior to and several years in advance of competition. The basic and

applied research cost of such a program would be staggering to the small company, when one considers that the combined R&D expenditures of the three or four leaders in the industry are somewhere around $200 million a year.

Even if we were to assume that the maverick could achieve a major technological break-through, it would not be of lasting significance, since few developments in electronics can be adequately protected against infringement or circumvention.

3. Profitable Operation through Geographical, Industrial, or Product Specialization Also Appears Improbable

It has been shown that application specialization is ultimately an unprofitable approach to the computer business. Geographical concentration appears equally unattractive for the same reasons: inadequate volume to handle the high cost of systems development and programming support. Industrial or product specialization also appear to be unlikely avenues of operation, for the versatility of today's general purpose computers is such as to make them quite competitive in virtually every industry and application. There may well be specific needs that can be better filled with a special purpose unit than with general purpose equipment. What these needs are, and whether they exist in sufficient quantity to warrant the relatively high development costs, is not known at this time. If they do exist, and can be identified, the next point should be considered.

(2) Successful Exploitation of Small, Special Purpose Segments of a Market Is Usually Accomplished by a Company with Certain Distinguishing Characteristics

The small company that assumes the role of the fringe supplier to an industry can usually be categorized as small, hard-hitting, and able to quickly identify, seize, and exploit an opportunity. Almost without exception, the successful maverick is set apart from its larger competitors by the following features:

1. The Successful Maverick Is Usually Owner-operated

The company that succeeds in this role is usually a proprietorship or partnership, owned and operated by one or more individuals that could be characterized as entrepreneurs. Each of the participants performs the functions of management, often doubling in brass, and certainly on a much lower overhead basis than would be found in the larger companies.

2. Success Is Often Built upon Personal Relationships

In many instances, the maverick company is started by former employees of one of the dominant corporations in the field who believe they have identified one or more segments of the market that are not being supplied by the larger competitors. The owner-management team is quick to exploit personal relationships throughout the industry in an effort to obtain a foothold and keep it. These contacts are used as a source of sales and information on possible market requirements and opportunities.

3. The Fringe Supplier Must Usually Assume a High Risk for a Low Profit

The segments of the market that are left to the maverick by the dominant companies in an industry are normally low volume and/or low profit. The small company runs a substantial risk that the larger company will "move in" at almost any time, if its particular segment appears profitable. Similarly, the small manufacturer must often depend upon innovation as a source of sales, which in turn increases his dependence on R&D and his risk. This high risk, low profit type of operation is normally characteristic of the maverick - not of the larger, well-established corporation.

In essence, it would appear that it is quite improbable that the computer business offers a lasting or significant opportunity to the small, fringe supplier that finds a place in many other industries. Furthermore, if such an opportunity were to develop as the computer business matures,

it is questionable whether Bendix, or, for that matter, any other large corporation, possesses the peculiar characteristics that contribute to the success of the "hit and run" or maverick company. Even if both of these conditions were met, it is doubtful that assumption of the maverick role in an industry of this size and scope represents the best utilization of the efforts and resources of a corporation with the strength and stature of Bendix.

10. BENDIX SHOULD DEVELOP A PROGRAM TO REDIRECT THE EFFORTS OF THE COMPUTER DIVISION

If the conclusions pertaining to Bendix's opportunities as:

- a supplier to the engineering and scientific computer market,
- a broad gauge supplier to the computer market in all of its facets,
- and as a maverick, or fringe supplier to small isolated segments of the market,

are accepted, Bendix is faced with the need to determine a specific course of action for redirection of the computer division's activity.

This needs to be planned very carefully in order to uphold Bendix's reputation as a company that stands behind its products. Furthermore, it will have to be carried out in a manner that would minimize possible operating losses stemming from personnel turnover, the return of leased computers, etc.

A specific program with a fair chance of success is far from apparent at this time. However, as a starting point, the following possibilities should be considered.

(1) Combination with Other Bendix Divisions

It is possible that one or more opportunities exist where a combination of the computer division's resources with other Bendix activities would prove beneficial. Such a combination could well make profitable use of the existing development, manufacturing, and distribution facilities. One possible combination might be within Bendix's numerically controlled machine tool area of interest. Undoubtedly, there are other opportunities which can and should be appraised.

(2) The Opportunities To Become an O. E. M. Supplier to the Computer Industry Should Be Considered

Although the business of making computers appears to be unprofitable because of the competitive situation, it is quite possible that a profitable business could be developed as a supplier of components, special equipment, or input-output gear to the other manufacturers. Since the supplier in this instance is selling directly to the manufacturer of the computer system, the problems and costs associated with an extensive marketing, programming support, and service program are avoided.

Bendix's experience as a computer manufacturer might also serve to make it a more qualified supplier of this market than some of the smaller companies in the field.

(3) Merger with One or More Other Companies in the Computer Field Should also Be Considered

The point has been made throughout our report that success in the computer business requires a sizable investment and a relatively large scale operation. There are almost a dozen companies that are now competing for a share of this market - and will fail to get it. Individually, these companies are too small and their resources too limited, at least with respect to their computer operations, to topple the three or four leading contenders.

It is possible that the merger with one or more of these companies could result in an organization of sufficient size and with large enough resources available to capture one of the top spots in this industry.

These represent three possible routes wherein Bendix's investment and experience in the computer business might be redirected in a manner which would provide a higher return on your shareholder's investment than appears probable under the present circumstances. There may possibly be others that should be examined as to their feasibility.

11. FINALLY, EVENTUAL LIQUIDATION OF THE DIVISION MUST BE CONSIDERED IF ALL OTHER COURSES OF ACTION FAIL

This alternative might offer Bendix the lowest loss on its investment from a short-term point of view, but the cost must be viewed in the light of the over-all Bendix position, not just that of the division alone. The impact of such a move could be very detrimental to the Bendix reputation and might handicap current or future corporate moves into other commercial or industrial markets, since potential customers would be concerned that here again Bendix might withdraw from the field.

It appears that, for the immediate future, Bendix must move forward with every outward appearance of remaining in this business, while the three alternative means of redirecting the division's effort are being explored in detail.

* * * * *

Unfortunately, the foregoing presents a rather dismal picture of the computer division's present position and its prospects.

We have arrived at our conclusions with considerable reluctance and only after long and careful consideration. We have sought out and obtained the best information available on this market and its probable future from qualified sources within and outside our firm. Our findings and our line of reasoning have been carefully reviewed with those of our

partners considered to be qualified in this area, for it is all too easy, in a situation such as this, to find that the competition is too great and calls for withdrawal. We would much rather present an action program that has a realistic chance of success and recommend that Bendix move forward with courage. In this case, however, we sincerely believe that the better choice for Bendix is to redirect the efforts of the division or liquidate the business.

In summary, it seems to us that large size is a must for success in the computer business and thus, in the end, in addition to IBM, only three or at the most four other companies will survive as suppliers of complete computer systems.

At the moment, there are at least four major companies and a host of lesser ones competing for these positions. While Bendix is fully their equal in its technical and manufacturing abilities, several of them are more experienced in commercial activities governed by market requirements rather than technical excellence of product. Also, they are more accustomed to situations where the initial investment is high with ultimate profits by no means assured and, in any case, several years away. Furthermore, several of them currently occupy a more advanced position in the market place than Bendix.

In our judgment, the probability of success for Bendix by itself is not worth the risk. It must either combine forces with others now in the field, redirect its operation toward supplying auxiliary or peripheral equipment, or withdraw entirely from the leased commercial computer business as such.

These alternatives need further study before a final conclusion can be reached.

This completes our reporting on our present assignment. The best answers we have been able to obtain to the specific questions covered by the proposal letter are contained in Section 7 on page twenty-two of this summary. The following series of appendixes contain the source and derivation of quantitative and other data used in this discussion.

Very truly yours,

APPENDIXES

INTRODUCTION

The following appendixes, describing recent developments in the computer market, while intended to stand as a complete current report, will be more meaningful if the reader has thoroughly familiarized himself with the Survey of the Market for the Bendix G-15D Computer dated February 1958. Much basic information is contained in the prior report that is not repeated in the following material. Therefore, familiarity with the prior study will add continuity and a more complete background of data on which to evaluate the recent developments in the computer market.

At the very beginning of the study, it became apparent that examination of that segment of the market of most interest to Bendix, namely, the engineering and scientific segment, could not be analyzed competently without first determining that segment's relationship with the rest of the market. For this reason, we felt compelled to present first a brief description of recent developments in the entire market to enable the reader to have a better understanding of developments concerning that segment of special interest. Appendix A, therefore, presents a brief discussion of developments in the total market, while subsequent appendixes deal with the market segment and equipment of special interest to Bendix.

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APPENDIX A (1)

RECENT DEVELOPMENTS IN THE COMPUTER MARKET

During the three intervening years since our last appraisal of the computer market for the Bendix Corporation, a number of significant changes have occurred. An appreciation of the magnitude and importance of these changes is essential to the development and utilization of a forecast of probable future events within this market.

While still a rapidly expanding market, its rate of growth has decelerated since the peak years of 1956-1957. Though undoubtedly affected by the 1958 business adjustment and deferment of computer procurement in anticipation of the availability of transistorized equipment, there are still sound indications that the market has progressed from a period of explosive growth to one of slower, but steady, expansion.

In addition to its tremendous size, the market has seen at least two other recent developments of significance to both users and manufacturers. These have been the introduction of a new generation of computers that utilize the latest developments in transistorized construction, core memories, and advanced logic, and the growth of intense competition in all segments of the market. Within the past few years, at least 16 manufacturers have entered the field; nearly all of them major

corporations of considerable size, some on an experimental basis, but others heavily committed to capturing a future profitable share of the market for themselves.

These two developments have contributed greatly to a certain amount of confusion in the market place, by tending to obscure segmentation of the market by system price, size, or application. This is illustrated in Exhibit A-1, following this page. The average or typical system is shown as a point, while the broad range of capabilities and prices that are possible through the addition of peripheral equipment and system modules is represented by the length of the bar. It is also important to note that the prices shown do not reflect used computers that have been discounted or systems that are possible through combinations of equipment, such as the IBM 1620-1410.

Since 1957, more accurate historical data have become available to aid in the analysis of the computer market. In view of Bendix's specific data needs with respect to the engineering and scientific market for the G-15, G-20, and G-25 systems, we have used the same basic size and application categorizations that were employed in our 1957-1958 report.

It should be pointed out, however, that the recent trend toward modular system design tends to obscure these traditional market divisions.

EXHIBIT A-1
BENDIX CORPORATION
COMPUTER SYSTEM PRICE RANGES

Similarly, the range of capabilities that are now possible through the addition of peripheral equipment clouds the picture even more. These changing conditions should be kept in mind as the market develops, so that the data and estimates contained in this report may be kept in their proper perspective.

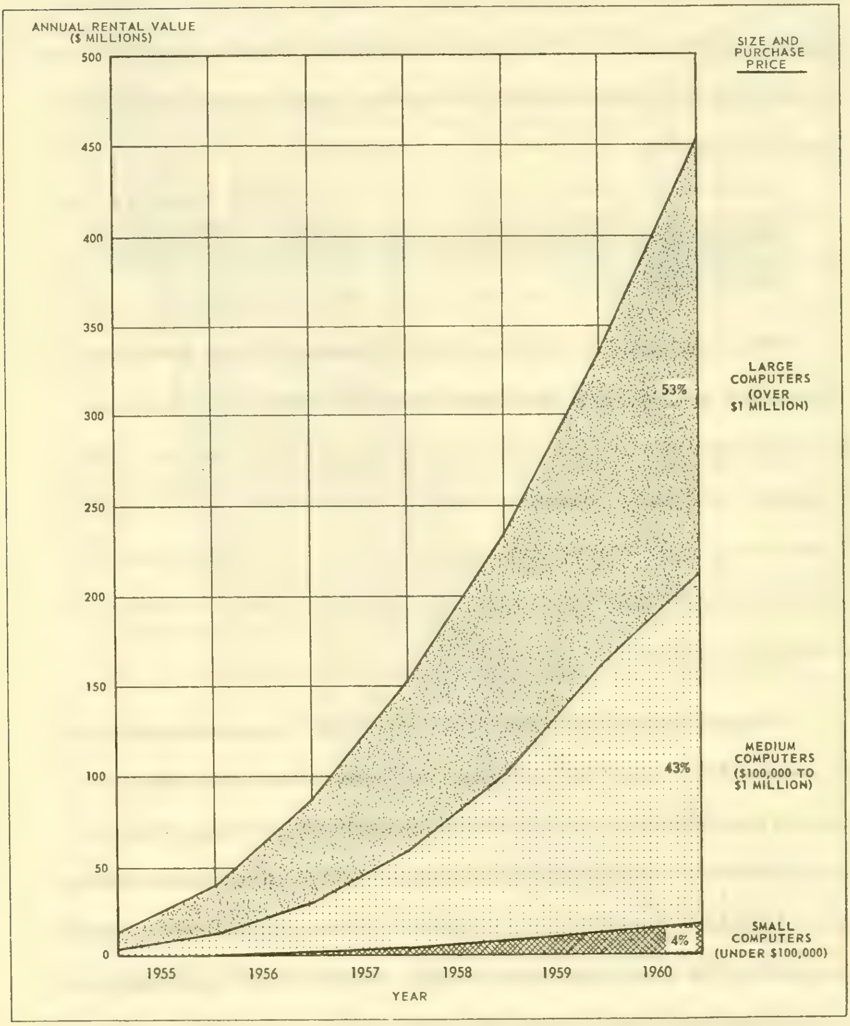
1. THE TOTAL ANNUAL RENTAL VALUE OF ALL INSTALLED COMPUTERS IS ESTIMATED TO EXCEED $450 MILLION AT THE END OF 1960

The rental value of installed digital computers of all sizes and applications has almost tripled since the end of 1957. It is estimated that this figure reached approximately $450 million at year-end 1960. Although the industry remains essentially rental-oriented, it is significant to note that the purchase value (in contrast to rental value) of outstanding equipment is currently well in excess of $1. 6 billion, also almost three times the 1957 value.

Industry sources indicate that annual sales, composed principally of revenue from rental installations, will reach $700 million by 1965, and the total purchase value of installed equipment will reach approximately $4 billion. Long-range projections indicate that annual revenue may be expected to reach about $1 billion by 1970, with a corresponding purchase value of $7 billion to $8 billion. Exhibit A-II, following this page, depicts the historical growth of this market since 1955, in terms of annual rental value and system size.

EXHIBIT A–II
BENDIX CORPORATION

ANNUAL RENTAL VALUE
OF ALL INSTALLED COMPUTERS
1955-1960



(1) Large Systems Currently Account for about 53% of the Total Annual Rental Value of All Installed Computers

The share of total rental value captured by large systems has declined steadily since 1955, when it was approximately 66%. The extremely high cost of these large systems continues to make it possible for a relatively small number of installations to account for a large share of the revenue, but the market for the large systems is confined to those users large enough to utilize the capacity and able to afford it. Thus, the growth rate of large system revenue is slowing more rapidly than other-sized systems.

(2) Medium Systems Currently Account for about 43% of Total Annual Revenue

In 1955, medium systems captured about 33% of the total annual revenue and during the past five years have increased that share to 43%, mainly at the expense of the large systems. The medium category remains the most rapidly growing size segment of the market. During the period 1955-1957, when small computers were driving a wedge into the market, the medium systems managed not only to maintain their share of the revenue, but continued to increase it. The availability of second generation large computers in 1960 caused a slight reduction in the share of total revenue going to medium computers, but it is anticipated that it will recover quickly and unquestionably be the

work horse of the industry. Wide capacity and price ranges have developed in this medium-size category, as shown in Exhibit A-I.

(3) Small Computer Revenue Has Stabilized at about 4% of the Total Annual Revenue

Prior to 1955, the least expensive digital computer available was the IBM 650 which started at around $3, 500 a month. In 1955, small computers entered the market to meet a need for equipment below this price, primarily in the engineering and scientific field. The G-15 and others of a similar type achieved immediate success and proceeded to capture a share of total computer revenue. The growth rate of this share seems to have stabilized at about 4% of the total during the past three years and gives every indication of remaining fairly constant with respect to total annual rental value. This is in part due to the current modular design approach and the availability of peripheral equipment which makes it possible for small computers to graduate into the medium category rather easily.

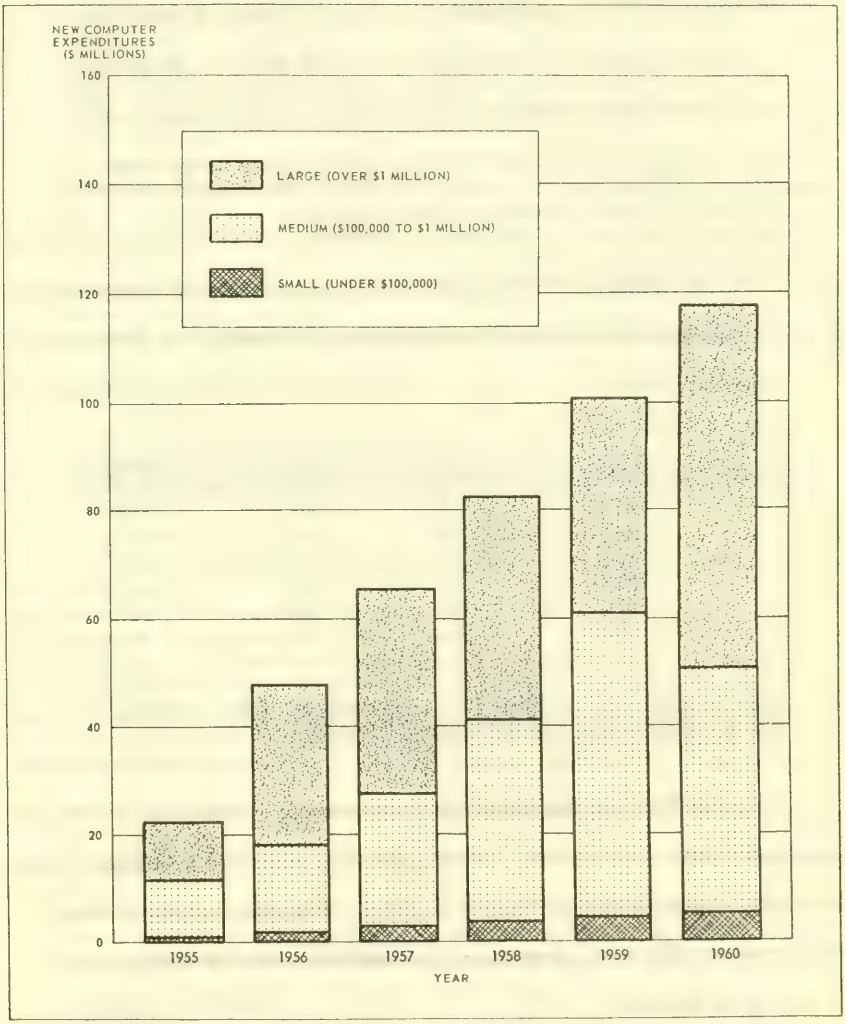
Another limiting factor on the growth rate of the small computer share of the market stems from their orientation to the engineering-scientific application area. This segment has reached maturity much more rapidly than the data processing area and its rate of growth is decreasing accordingly. Exhibit A-III, following this page, illustrates the distribution of new rental revenue*

* "New rental revenue" or "new money" represents the net gain in the annual rental value of installed equipment from year-beginning to year-end.

EXHIBIT A–11

NDIX CORPORATION

ANNUAL INCREASES IN RENTAL VALUE,
INSTALLED COMPUTERS
1955-1960



entering the market since the end of 1954, and graphically shows the wedge that small computers created. It also indicates that the growth pattern for small computers has followed essentially the same pattern as the large and medium-size systems, though several years later. Each of these will, in time, follow the normal "S" curve pattern of most products.

The following table portrays, by size, the shift in per cent distribution of total annual rental value of all computers for the indicated years.

Year	Small	Medium	Large
1955	1%	33%	66%
1956	2	34	64
1957	3	36	51
1958	4	39	57
1959	4	44	52
1960	4	43	53

2. THE NUMBER OF INSTALLED COMPUTER UNITS REACHED AN ESTIMATED 4,886 BY THE END OF 1960

Between 1955 and the end of 1960, an average of 900 units of all sizes were installed each year, raising the total computer population from about 363 installations in 1955 to about 4,886 installations in 1960. The following table depicts the cumulative annual installations and share of total units by size.

Year	Total Units	Small Number	Small Per Cent	Medium Number	Medium Per Cent	Large Number	Large Per Cent
1955	363	24	6%	260	72%	79	22%
1956	883	128	15	594	67	161	18
1957	1,629	329	20	1,034	64	266	16
1958	2,615	591	23	1,657	63	367	14
1959	3,876	914	24	2,494	64	468	12
1960	4,886	1,284	26	2,990	61	612	13

In terms of numbers of units installed, it is evident that the proportion of large and medium installations is declining, while the proportion of small units is increasing. A comparison with an analysis of the total rental value by size points out the difference that is made by the extreme prices of the various size units.

3. THE PER CENT DISTRIBUTION OF REVENUE BY COMPUTER APPLICATION HAS SHIFTED SIGNIFICANTLY IN RECENT YEARS

Originally, computers were used predominantly in the engineering and scientific field, secondarily in the data processing field, and lastly in the relatively new and confined field of process control. In recent years, there has been a significant shift in computer utilization to the point where data processing is now the primary application. The following table illustrates the per cent distribution of annual rental revenue by applications.

Application	BA&H 1958 Report	BA&H 1960 Individual Machine Analysis	1960 Industry Sources
Engineering and Scientific	58%	36%	35%
Data Processing	40	62	63
Process Control	2	2	2
Total	100%	100%	100%

(1) The Business Data Processing Application Is the Most Significant Growth Area

Data processing applications currently account for the largest single share of total computer revenue. This application also appears to represent the probable segment of greatest future growth. Competing manufacturers seem to have recognized this trend and are mounting efforts to share in this field. The basic approach being employed by most of them is to increase machine flexibility for engineering and data processing work, thus encouraging and benefiting from a trend toward greater dual utilization of equipment.

(2) Engineering and Scientific Work No Longer Represents the Principal Application of Digital Computers

There is no longer any real distinction between engineering-scientific and data processing equipment. This increased machine flexibility has come about as a result of the pressure in the market place for dual usage and the desire on the part of many manufacturers to build in as wide a range of capabilities as possible, in order to expand the potential market for a basic system. While some machines have slight advantages for one use or the other, the equipment generally is moving toward wide application in both areas.

While there is, and probably will remain, a market for strictly computational engineering and scientific applications, it will continue to decrease in size with respect to the total. The major share of the market will be served by machines having capabilities in both areas. This is simply because technical problems involve an increasingly larger amount of basic data handling and processing as the user becomes more sophisticated in the use of computers. Similarly, expanded use of operations research techniques by management calls for computational capabilities in a data processing machine that are not too different from those required by the technical personnel within the company.

As this merger of machine capabilities expands, the economic pressure to use one machine for both applications will mount. Thus, it would appear that the benefits to be derived from application specialization through equipment design orientation no longer exist to a significant degree. There is real reason to suspect that the same is true as far as the benefits of sales specialization in the E&S <u>or</u> data processing areas are concerned.

(3) Process Control Is the Slowest Growing Field of Application

Opportunities seem to exist in the future in the area of computer process control, and ultimately this more "exotic" application of computers may prove to be a more substantial market than the engineering and scientific area. At present, about 2% of the total annual rental value is going into this area, and at least one manufacturer has indicated that it would specialize in this field. However, process control applications require justification on a more limited basis and do not lend themselves readily to dual application. The process control computer market is one of relatively slow growth currently, but industry sources indicate that it will grow to very substantial proportions in the long-range future.

4. THE COMPUTER INDUSTRY CONTINUES TO BE DOMINATED BY ONE MANUFACTURER

IBM continues to direct the industry and, with the exception of the small machine market, continues to enjoy an overwhelming position in the entire field. In the small computer market, IBM had no competitive product and other manufacturers, stepping into this gap, were able to gain a foothold in the past five years. However, IBM has recently introduced the model 1620 and will aggressively seek to restore its complete dominance in all sizes of equipment in the near future. Published reports of orders received indicate that this is not wholly speculation.

(1) There Is a Small Portion of Total Annual Rental Value Left by IBM for Other Manufacturers To Share

An individual machine analysis of the entire market reveals that IBM and Remington Rand leave a very small share of the total annual rental revenue to other manufacturers. The following table shows the complete dominance of these two suppliers, both of whom are heavily committed to, and deeply entrenched in the large and medium-size machine field, where most of the rental dollars are concentrated.

Manufacturer	1955	1956	1957	1958	1959	1960
IBM	91%	86%	79%	73%	70%	70%
Remington Rand	9	10	14	18	17	18
Others	-	4	7	9	13	12
Total	100%	100%	100%	100%	100%	100%

As the following data indicate, the area of the small computer is the only area where there has been any real measure of competition and, as previously pointed out, this was essentially because IBM had no successful competitive machine in this size category.

PER CENT OF ANNUAL RENTAL VALUE OBTAINED BY MANUFACTURER
1960

Manufacturer	Large	Medium	Small	Total
IBM	77%	68%	-%	70%
Remington Rand	19	17	-	18
Bendix	-	-	35	-
Royal McBee	-	-	35	-
Burroughs	-	9	16	5
Others	4	6	14	7
Total	100%	100%	100%	100%

(2) Recent Product Announcements Indicate That IBM and Remington Rand Continue To Dominate the Computer Equipment Field

Of the 18 large computer systems being offered to the market at the present time, nine are IBM products and five are Remington Rand's. The remaining four are offered by as many manufacturers.

In the medium-price category, there are 15 machines available, of which only three are IBM products, but they account for 75% of all the installations to date. A considerable amount of competition has entered this particular segment of the market, probably in the hope of replacing a large number of the more than 1,500 IBM 650's that are currently in use.

In the small computer segment, we also find that competition has increased several times over. In 1957-1958, the G-15 faced four competitors in the less than $3,000 price class. Today, there are more than a dozen models being offered, with no more than two from any one manufacturer.

* * * * *

This appendix has dealt primarily with recent developments in the computer industry and their probable effect upon the future. To the extent practical, general market conditions have been set forth with respect to

the various segments of the market and the contenders for them. Appendix B, following, will deal with the derivation and analysis of those portions of the market which hold particular current and future interest for the Bendix Computer Division.

APPENDIX B (1)

DERIVATION OF THE MARKET

The preceding appendix, discussing the general aspects of recent computer market developments, provides a background on which to base an analysis of that segment of the market which is of particular interest to Bendix and to develop a reasonable forecast of numbers of units that are likely to be installed over the next five-year period.

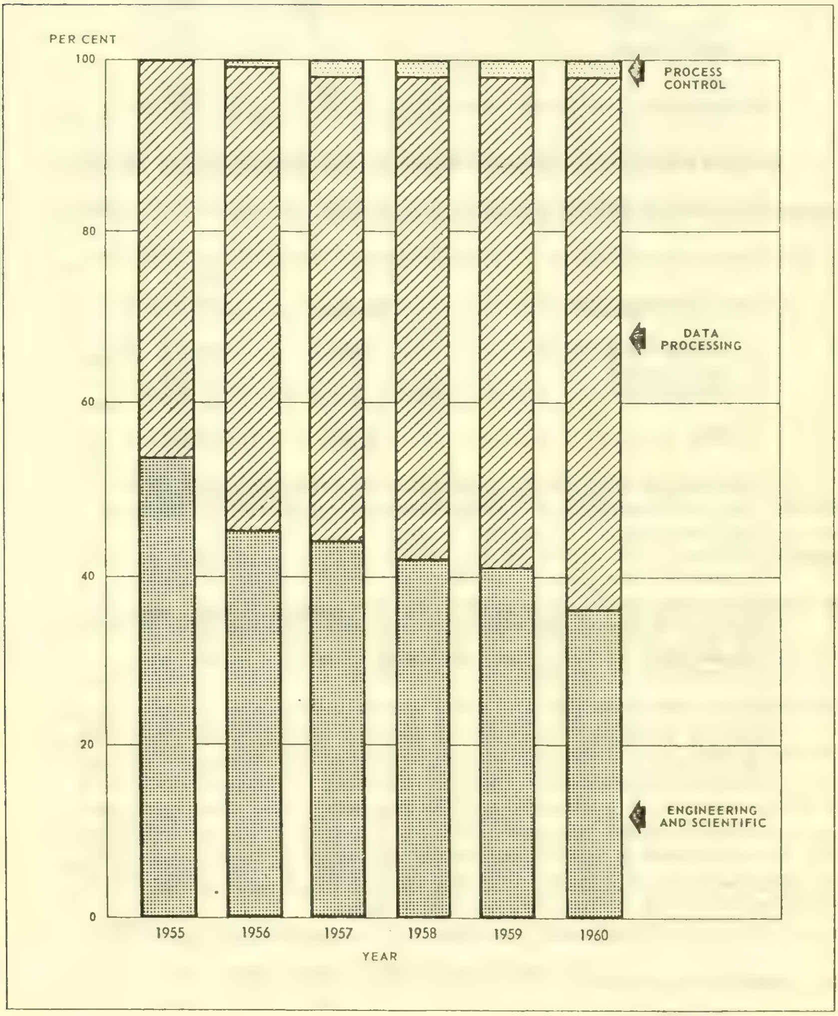
The market area of specific interest to Bendix, and hence the subject of this appendix, is the engineering and scientific field of application and the size categories within this field of application in which the G-15D, G-20, and G-25 will have to compete.

1. THE ENGINEERING AND SCIENTIFIC APPLICATION NO LONGER ACCOUNTS FOR THE LARGEST SHARE OF COMPUTER TOTAL ANNUAL REVENUE

Industry sources, user interviews, and an individual evaluation of each machine on the market indicate that there has been a substantial shift in predominant computer application in recent years. The following data present an evaluation of this shift in proportion of total annual rental value, by application. Exhibit B-I, following this page, illustrates the history of this shift.

EXHIBIT B–I
BENDIX CORPORATION

PER CENT DISTRIBUTION OF TOTAL
COMPUTER RENTAL VALUE BY APPLICATION
1955-1960



APPENDIX B (2)

Application	1957	1960
Engineering and Scientific	58%	36%
Data Processing	40	62
Process Control	2	2
Total	100%	100%

On this basis, the estimated $453 million of total annual rental value at year-end 1960 is apportioned as follows:

Application	Per Cent	Dollars (Millions)
Engineering and Scientific	36%	$164.4
Data Processing	62	280.1
Process Control	2	8.7
Total	100%	$453.2

Users, who are becoming more experienced and mindful of the economics involved, are requiring dual usage of their equipment by their technical and data processing staffs. In recognition of this, manufacturers are making available machines with capability in both areas. The former areas of design and sales specialization are now obscured, and the growth rate of the engineering and scientific computer market, as such, has slowed accordingly. The following table illustrates the drop in percentage of new annual rental money going to the engineering and scientific field during the past five years.

	1955	1956	1957	1958	1959	1960
New Money Going to E&S	61%	37%	44%	38%	38%	23%

(1) Large Systems Are Used Predominantly in the Data Processing Field

Less than 42% of the total annual rental value represented in large systems is devoted to engineering and scientific applications. In terms of units, 64% of the available large units, although having some capability in both applications, are aimed primarily at the data processing field. Many of the most recent entries into the market are directed exclusively to data processing work. Extreme prices of these units cause considerable concentration of rental value dollars in this size category.

(2) Medium-size Systems Are Data Processing-oriented to a Greater Degree than Any Other Size Category

Only 27% of the funds directed into annual rental value of medium-size systems are channeled to engineering and scientific applications. In terms of units, nearly 80% of all available medium-size systems are applied primarily in the data processing field. With the exception of the G-20, the tape-equipped Alwac III-E, and the Ramo Wooldridge 400, every other medium-size unit is applied primarily in the data processing area, while having some capability in both areas. As in the case of large systems, many of the newest units out are aimed mainly at the data processing

field. The percentage of total annual rental value directed to engineering and scientific application in the medium-size category has dropped sharply since 1955.

(3) Small Computers Still Are Serving Primarily the Engineering and Scientific Field, but to a Lesser Extent than Before

About 64% of the total annual rental value accounted for in small computers is going to the engineering and scientific field of application. Of the available unit models, 59% are applied primarily to engineering and scientific applications, but there is increasing pressure to provide dual capability in this size category also. The relatively stable proportions of both total annual revenue and new money devoted to engineering and scientific applications in this size category in recent years indicates a rather rapid maturing of this market and that future growth will likely be based on dual capability, rather than application specialization. Here again, manufacturers have recognized this and the most recent entries into this market, especially the IBM 1620, are designed to serve this expanding dual usage field. There is a much more extensive present and future market of small users to be served by dual capability, than there is to be served by specialized equipment.

(4) While Small Computers Continue To Serve the Engineering and Scientific Area Primarily, It Is Evident That Data Processing Capability Must Be Provided in All Sizes of Equipment

As pointed out in the 1957-1958 report, the data processing market still appears to offer the greatest ultimate growth and potential. With the trend toward dual usage established by a real demand in the market, it appears that the opportunity for uniqueness and specialization in the engineering and scientific area no longer exists, particularly in the medium-size category where the G-20 will have to compete.

The following table illustrates the recent history of the percentage of total annual rental value for each size category applied to the engineering and scientific field.

	Small	Medium	Large
1955	63%	57%	52%
1956	52	52	40
1957	61	46	43
1958	70	41	41
1959	73	33	45
1960	64	27	41

2. THE ENGINEERING AND SCIENTIFIC COMPUTER MARKET SHOULD REACH APPROXIMATELY $400 MILLION IN TERMS OF ANNUAL RENTAL VALUE BY 1965

The amount of money spent for the rental or depreciation of computers to support the work of engineering and scientific personnel

remains the key figure in appraising the probable future of this market. This dollar-expenditure-per-man method was fundamental to the development of our 1957-1958 G-15D analysis.

(1) <u>About 798,000 Engineers and Scientists Will Have Use for Computers by 1965</u>

The National Science Foundation has revised its forecast of the United States' engineering and scientific population slightly upward since our 1957-1958 report. This has increased the 1960 estimate from 1,000,000 to approximately 1,030,000, or an increase of about 3%. The 40% exclusion factor, which was used in our prior study and which was based on the size of companies employing engineering and scientific groups, and the size of the groups themselves, still appears to be valid. Application of this factor to the revised population forecast indicates that the users' group will expand from about 618,000 as of year-end 1960 to approximately 798,000 by the end of 1965.

(2) <u>It Still Appears That Annual Expenditures for Computers for Engineering and Scientific Use Will Level off at about $500 per Man</u>

The actual rate of growth in expenditures per man has fallen somewhat short of our 1957-1958 projection. The 1958 general business readjustment, manufacturers' inventory

adjustments, and the curtailment of new computer commitments during the change-over from the earlier tube and drum machines to the new transistorized equipment caused a temporary deceleration of growth between 1957 and 1961. This has resulted in a delay in achieving the \$500-per-man level anticipated in our earlier analysis.

Based on current industry data, it appears that the market will resume its expected growth rate in 1961 and the \$500-per-man level will be reached in about 1965, instead of 1962. Exhibit B-II, following this page, consists of three curves reflecting:

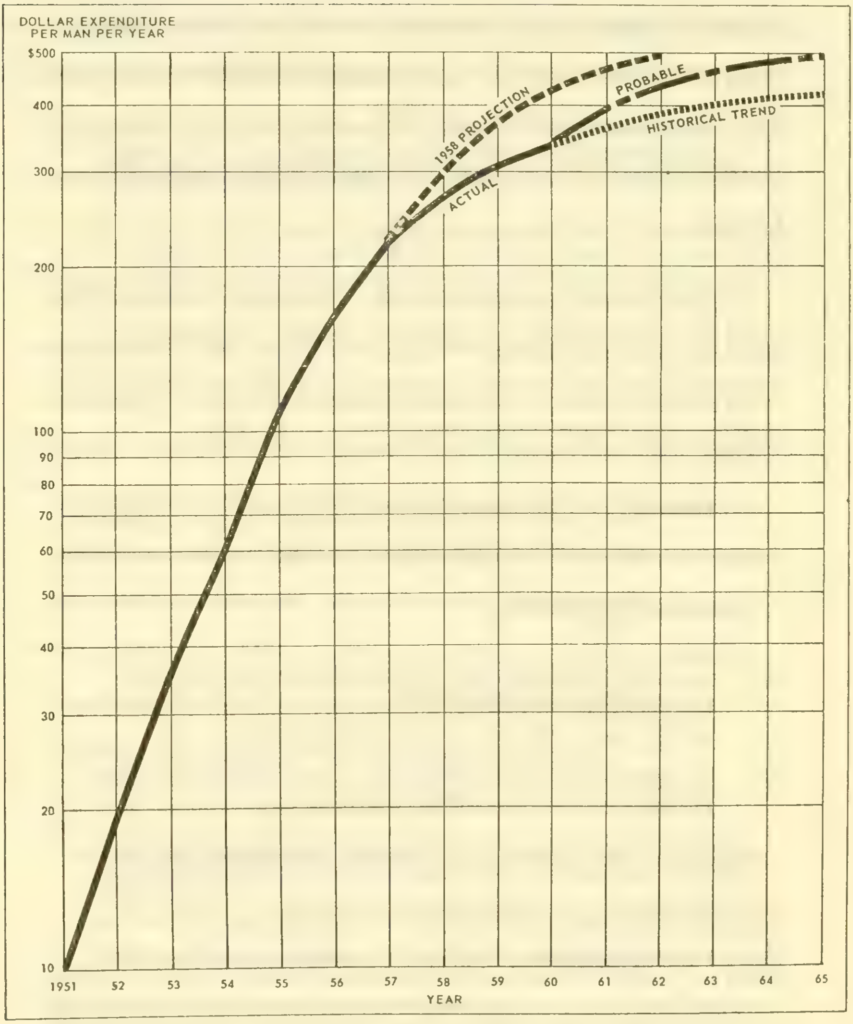
- The projected growth in expenditures per engineer and scientist from our 1958 report.
- The actual growth to date and the resulting historical trend.
- Our best estimate of what will probably occur between now and 1965.

(3) An Estimated 798,000 Potential Users at \$500 per Year Each Will Provide a \$400 Million Market

The combination of 798,000 eligible users of engineering and scientific computational aids, and an expenditure level of \$500 per man in 1965, indicates an engineering-scientific market of approximately \$400 million five years hence. Current expenditures are estimated to be \$212.6 million, including approximately

EXHIBIT B–II
BENDIX CORPORATION

GROWTH PATTERNS OF ENGINEERING AND SCIENTIFIC MARKET BASED ON HISTORICAL EXPENDITURES



$48 million for punched card calculating equipment, which will be subject to replacement by computers during the next five years. Exhibit B-III, following this page, shows this projection graphically. Note that growth slowed significantly during 1958, was relatively normal in 1959, and slowed again in 1960. The reasons for these two cutbacks in new commitments were discussed earlier. We would anticipate that 1961 will be a good year for the industry, since the second generation computers will be available for delivery. The market should continue to mature until most of the potential computer requirements have been filled.

Exhibit B-IV, following Exhibit B-III, consists of a comparison between this revised estimate and the forecast contained in our 1957-1958 report.

(4) A Second Forecast, Based on Federal Research and Development Expenditures, Indicates a Total Engineering and Scientific Market of About $380 Million in 1965

In order to cross-check the estimate derived from our "dollar-per-man" technique, a second, independent forecast was developed based upon federal R&D expenditures. Historical annual R&D expenditures and E&S computer expenditures were reduced to indexes, in an effort to identify any direct correlation

HIBIT B–III
BEN..X CORPORATION

HISTORICAL AND PROJECTED GROWTH
OF THE ENGINEERING AND SCIENTIFIC MARKET
1953-1965

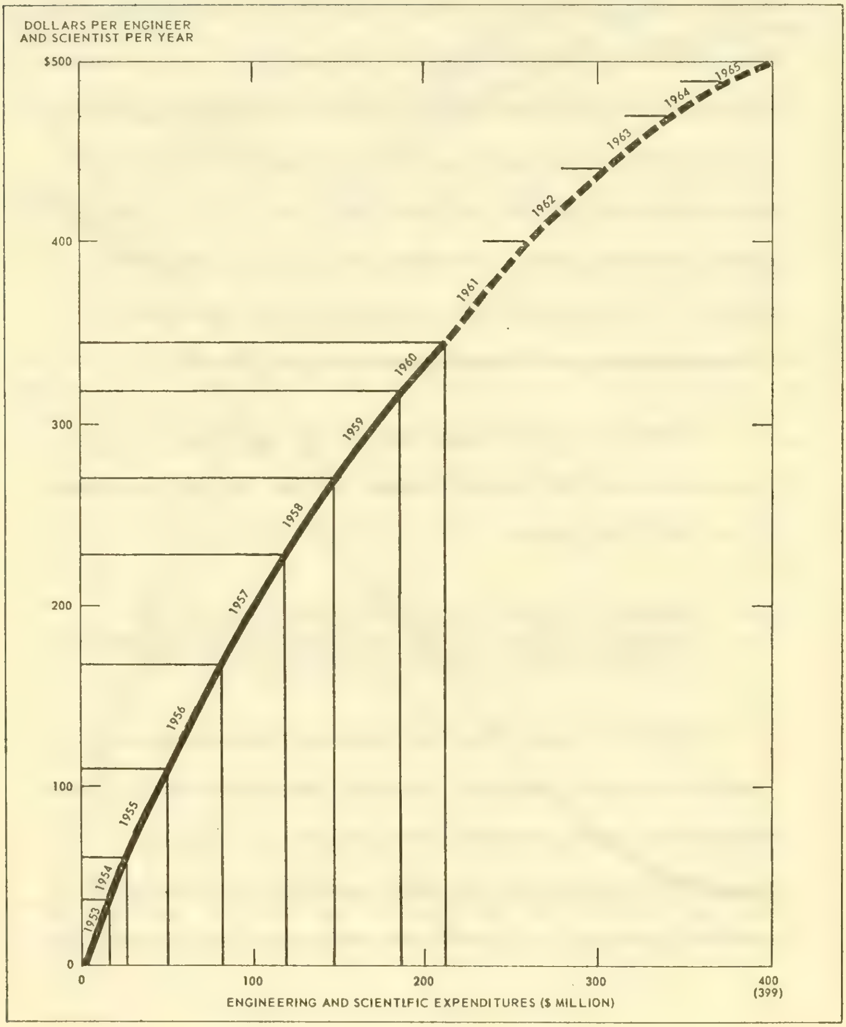
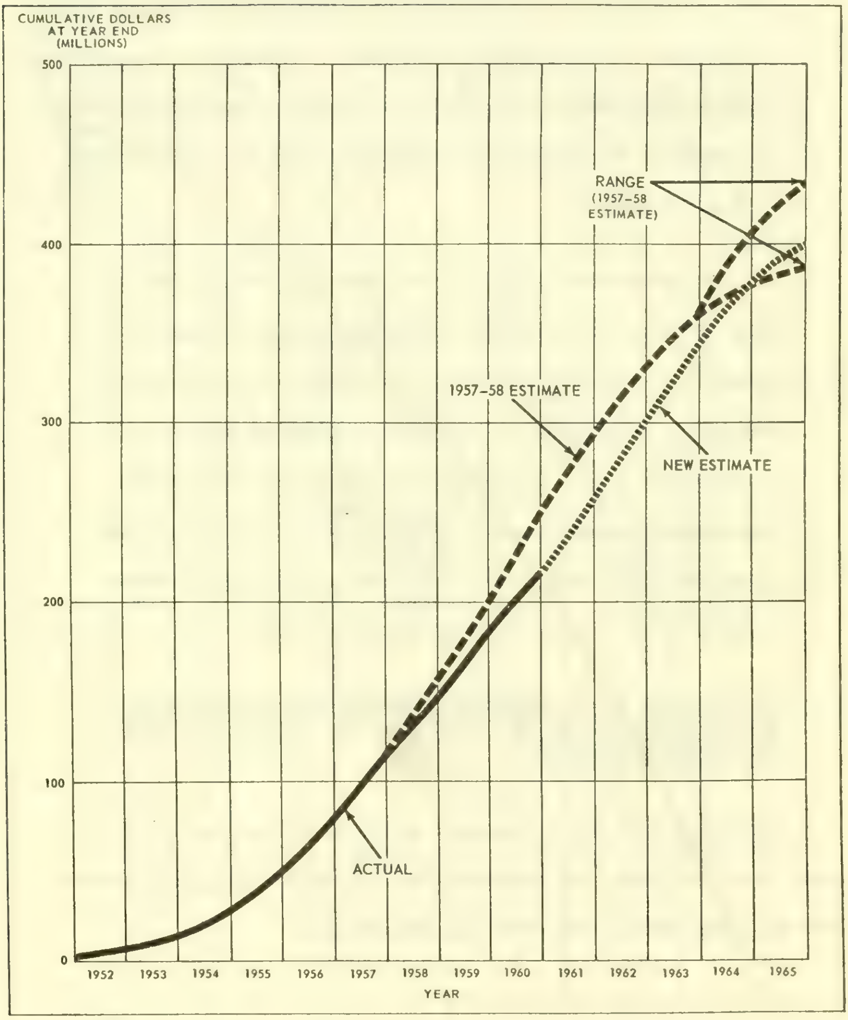


EXHIBIT B–IV
BENDIX CORPORATION

ANNUAL EXPENDITURES FOR ENGINEERING AND SCIENTIFIC COMPUTERS AND PUNCH CARD CALCULATORS



that might exist. The rapid growth of the computer field in recent years and the size and growth rate of the federal R&D budget have not borne a direct historical relationship. Analysis of the percentage relationship between computer expenditures and the budget does indicate that the former has rapidly risen to a level of about 2.4% and leveled off.

If we assume that this percentage will rise to 2.5% and apply it to an estimated 1965 R&D budget of $15.3 billion, it results in a 1965 E&S computer expenditure level of about $380 million. The basis for this forecast is shown as Exhibit B-V, following this page. The closeness of this forecast of $380 million and the base forecast of $399 million arrived at by the dollar-per-man method leads us to believe that the attainment of these levels is well within the realm of reason.

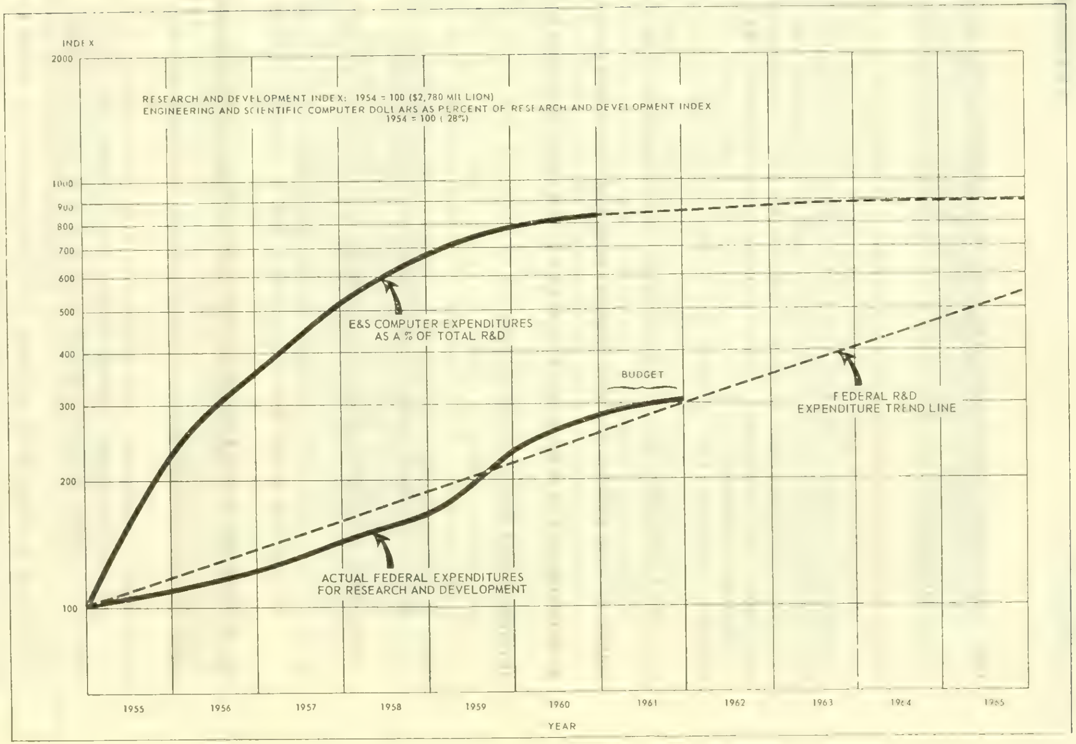
3. IT APPEARS THAT THE ENGINEERING AND SCIENTIFIC MARKET WILL ABSORB BETWEEN 1800 AND 2300 SMALL COMPUTERS BY 1965

The market for small computer units for the next five years is made up of two parts: new expenditures in the engineering and scientific area for small computers, and replacement units.

EXHIBIT B-V

BENDIX CORPORATION

THE RELATIONSHIP OF FEDERAL RESEARCH AND DEVELOPMENT EXPENDITURES TO THE ENGINEERING AND SCIENTIFIC MARKET



(1) New Expenditures in the Engineering and Scientific Area Are Forecast To Reach about $186 Million in the Next Five Years

By applying a sliding scale percentage of new funds going into small computers, based on historical performance and anticipated performance, it can be determined that about $21 million, or about 11%, of these new funds will be channeled into the small computer area. Based on an approximate annual rental figure of $18,000 for a small engineering and scientific computer, it is estimated that between 1,000 and 1,500 new units will be absorbed into this market by 1965.

(2) There Is an Additional Market of about $214 Million, Based on the Replacement of Some Existing Punched Card Equipment by Computers and the Obsolescence of Existing Computer Installations

In addition to the new engineering and scientific expenditures forecast of $186 million, there is a replacement market, made up of punched card calculator installations that will be replaced by computers, and of present computer installations that will become obsolete for technical or economic reasons, amounting to about $214 million. The combination of these two markets gives us our 1965 total engineering and scientific market of about $400 million mentioned previously and portrayed graphically in Exhibit B-III of this appendix. It is not reasonable to

expect that all calculators and punched card installations will be replaced by computers within the next five years, and some computers that have been purchased outright will not be subject to the normal four- to five-year obsolescence factor, but for purposes of this analysis, it is reasonable to expect that most will. If about 7% of this $214 million engineering and scientific replacement market is channeled to small computers, as has been historically the case, and this result is translated into units, there are 800 additional engineering and scientific units to be considered as part of this market. This then gives us a total of 1,800 to 2,300 small computer units, new and replacement, to be absorbed into the engineering and scientific market by 1965.

4. IT IS ESTIMATED THAT THE ENGINEERING AND SCIENTIFIC MARKET WILL ABSORB BETWEEN 700 AND 800 G-20 TYPE UNITS DURING THE NEXT FIVE YEARS

This market likewise consists of two segments, new engineering and scientific expenditures and replacement expenditures.

(1) About $68 Million of the $186 Million Total Engineering and Scientific Expenditures Is Forecast To Go for Medium-size Computers

By applying a percentage, based on historical and anticipated performance, to the total anticipated annual expenditures for engineering and scientific computers, we are able to estimate

that approximately $68 million of this new money will be spent for medium-size computers - the area in which the G-20 will have to compete - by 1965. Based on the annual rental price of a representative system, it is estimated that this amount represents the addition of about 450 new engineering and scientific units during the next five years.

(2) There Is an Additional Replacement Market of about 300 Units

As in the case of small computers, not all the medium units now in use will be replaced, but it is reasonable to assume that most will be replaced or upgraded into large systems. Based on historical relationships of the proportion of engineering and scientific funds allocated to medium-size units, we estimate that it is reasonable to expect that approximately 300 of the engineering and scientific units now installed will be subject to replacement during the next five years. This replacement market, combined with the anticipated new expenditures, indicates a medium-size engineering and scientific market equivalent to about 750 G-20 type units.

5. <u>THE REMAINDER OF THE MARKET INDICATES A TOTAL OF 300 TO 400 LARGE ENGINEERING AND SCIENTIFIC UNITS WILL BE ABSORBED BY 1965</u>

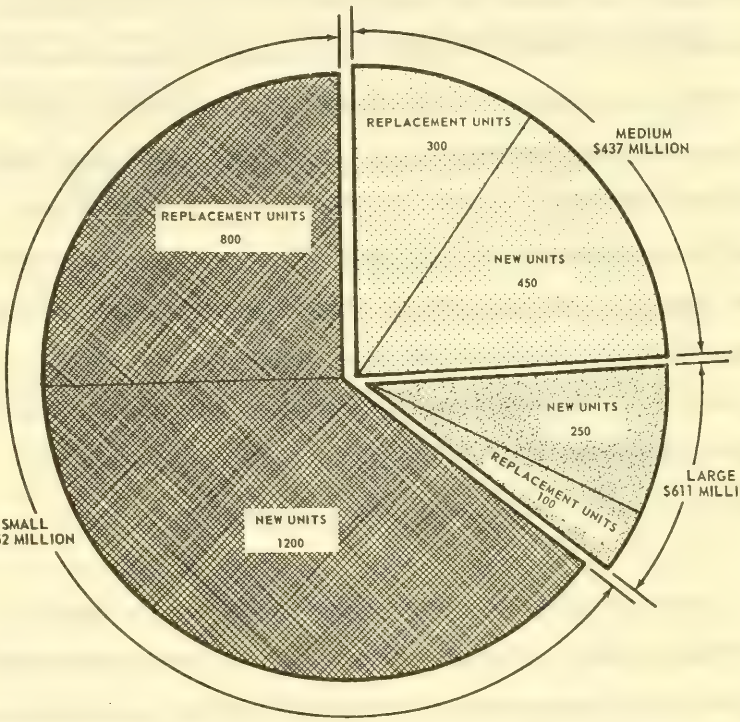
On the basis of historical and anticipated relationships demonstrated in the small- and medium-size categories, our analysis indicates that about $97 million of the $186 million expenditures for engineering and scientific computers will be concentrated in large scale units. Based on representative prices of large units, it is estimated that about 250 units will be added to the market by 1965. In addition to this, there should be a replacement market of about 100 engineering and scientific units, indicating that the market will absorb the equivalent of about 350 large scale engineering and scientific units in the next five years. Exhibit B-VI, following this page, illustrates the segmentation of the engineering and scientific market in terms of units and rental value.

* * * * *

This appendix has presented our best estimate, derived by two independent methods, of the probable size of the market for engineering and scientific computers between now and 1965. This base estimate has been further broken down in terms of new (net additions to the population) and replacement units within the large, medium, and small categories.

EXHIBIT B-VI
BENDIX CORPORATION

ENGINEERING AND SCIENTIFIC COMPUTER
MARKET POTENTIAL
1960-1965



TOTAL SALE VALUE OF MARKET $1.2 BILLION

It should be noted that although these various estimates appear reasonable today in light of the historical and probable future developments within this market, they are only estimates and should be subjected to periodic review in order to determine the impact of events that are not foreseeable at this time.

These estimates provide the basic market facts requested by Bendix in accordance with our original proposal. Exhibits B-VII, B-VIII, and B-IX, following this page, present summary tabulations of the basic statistical data developed during the course of this study and upon which the market estimates were based.

Appendixes C and D which follow, present comparative technical evaluations of the Bendix G-15 and G-20 computers. These have been developed to aid in the determination of the relative competitive position of current Bendix products.

EXHIBIT B-VII
BENDIX CORPORATION
SUMMARY OF BASIC MARKET DATA

Computer Units and Computer Rental or Equivalent Depreciation Values (All Dollar Values in Thousands)

Year End (Dec. 31)	Net Gain (12 Mos.)	Small: Engineering and Scientific	Small: Total Value	Small: Number of Units	Medium: Engineering and Scientific	Medium: Total Value	Medium: Number of Units	Large: Engineering and Scientific	Large: Total Value	Large: Number of Units	All Sizes: Engineering and Scientific	All Sizes: Total Value	All Sizes: N[illegible] of[illegible]
1951		$	$		$	$		$ 216	$		$ 216	$	
	+ 1952 Gain							360			360		
= 1952								576			576		
	+ 1953 Gain							1,597			1,597		
= 1953								2,173			2,173		
	+ 1954 Gain				1,974			3,690			5,664		
= 1954					1,974	2,015		5,863			7,837		
	+ 1955 Gain	308	488		5,382	11,006		7,723	10,708		13,413	22,202	
= 1955		308	488	24	7,356	13,021	260	13,586	25,872	79	21,250	39,381	
	+ 1956 Gain	796	1,636	104	7,955	16,438	334	8,928	29,796	82	17,679	47,870	
= 1956		1,104	2,124	128	15,311	29,459	594	22,514	55,668	161	38,929	87,251	
	+ 1957 Gain	1,963	2,954	201	9,396	24,351	440	17,488	38,160	105	28,847	65,465	
= 1957		3,067	5,078	329	24,707	53,810	1,034	40,002	93,828	266	67,776	15 6	
	+ 1958 Gain	3,299	3,961	262	12,208	37,500	623	16,163	41,448	101	31,670	82,909	
= 1958		6,366	9,039	591	36,915	91,310	1,657	56,165	135,276	367	99,446	235,625	
	+ 1959 Gain	3,580	4,619	323	11,456	56,437	837	22,633	39,324	101	37,669	100,380	
= 1959		9,946	13,658	914	48,371	147,747	2,494	78,798	174,600	468	137,115	336,005	
	+ 1960 Gain*	1,928	5,018	370	4,085	45,556	496	21,295	66,672	144	27,308	117,246	
= 1960*		11,874	18,676	1,284	52,456	193,303	2,990	100,093	241,272	612	164,423	453,251	

*Estimated for second half of year.

EXHIBIT B-VIII

BENDIX CORPORATION

SUMMARY OF BASIC MARKET FORECAST DATA

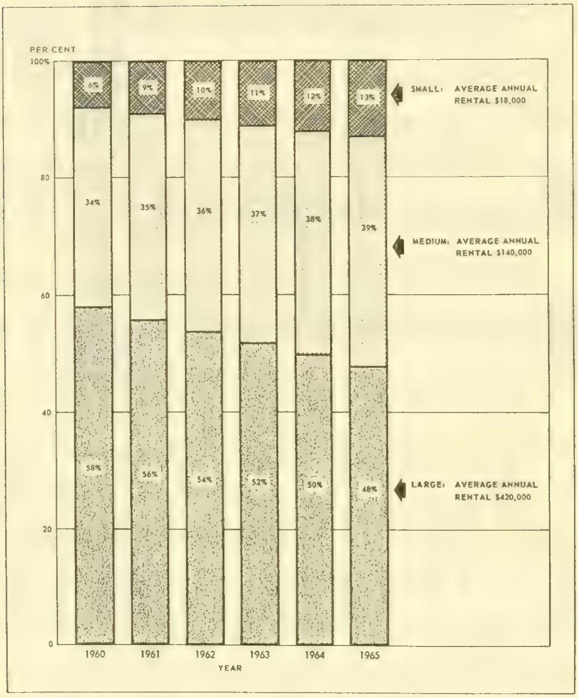
Year	Eligible Manpower (000's)	Dollar Expenditures per Man	Engineering and Scientific Expenditures(1) (millions) Calculator Base	Computers Only	Total New Money (millions)	New E&S Money (millions)
1952	360	$ 19	$ 6.9	$ 0.6	$	$
1953	390	36	13.9	2.2		
1954	420	60	25.0	7.8		
1955	450	109	49.0	21.2		
					47.0	31.5
1956	480	167	80.5	38.9		
					65.0	35.5
1957	510	228	116.0	67.8	Computers Only (1)	
					83.0	31.6
1958	546	270	147.6	99.4		
					100.0	37.7
1959	582	318	185.3	137.1		
					117.0	27.3
1960	618	345	212.6	164.4		
					136.0	49.0
1961	654	400	261.6	213.4		
					117.0	42.0
1962	690	440	303.6	255.4		
					104.0	37.6
1963	726	470	341.2	293.0		
					89.0	32.2
1964	762	490	373.4	325.2		
					71.0	25.6
1965	798	500	399.0	350.8		

Total new engineering and scientific expenditures 1960-1965 $186.4 million

(1) For purposes of continuity with the 1957-1958 report and evaluation of the calculator replacement market, two curves of similar shape were developed, one with calculator value base, and the other computers only.

E) IT B–IX
BENDIX ›RPORATION

PROJECTED PERCENT DISTRIBUTION OF
NEW ENGINEERING AND SCIENTIFIC FUNDS, BY SIZE
1960-1965



APPENDIX C

APPENDIX C (1)

COMPARATIVE TECHNICAL EVALUATION OF THE BENDIX G-15 COMPUTER

As an aid in the evaluation of the probable future market penetration of the Bendix G-15 computer, a comparative study was made of its features, performance, and capabilities against those of other units with which it must compete. This study was done in cooperation with the Bendix Computer Division marketing and engineering departments in order to benefit from all available data and to minimize possible duplication of effort.

The highlights of this evaluation are presented on the following pages.

1. THE G-15 HAS BEEN MOST SUCCESSFUL IN THE ENGINEERING-SCIENTIFIC MARKET

Of the three major areas of application for small general purpose computers - engineering-scientific, data processing and process control - the G-15 has achieved its most notable success in the technical area. This has come about as a result of the closeness of fit between the original design of the equipment and the needs of this segment of the market. In addition, the sales efforts of the division have largely been directed to this type of user.

APPENDIX C (2)

(1) <u>The G-15 Was Developed To Fulfill the Needs of the Engineering-Scientific User</u>

The G-15 has a number of inherent design features which make it particularly well suited to the solution of complex engineering and scientific problems. These features were selected during the design process in order to improve the usefulness of the machine to the technical user, while keeping the price below that of equipment designed to be equally adept at scientific or business data processing. Specifically, these features include:

. Highly flexible internal computing facilities.

. A wide range of available machine commands.

. Augmented storage capacity through inexpensive magnetic tape units.

. Availability of the DA-1 digital differential analyses and PA-3 graph plotter accessories.

. High-speed punched paper tape input and output.

. Sixteen words of fast access memory.

Each of these features, along with the interpretative routines and machine language programs available from Bendix and through the G-15 users' organization, has contributed to the usefulness and customer acceptance of the G-15 over the past four years. Approximately 90% of the more than 300 machines sold or leased to date are principally used in the solution of problems of a technical nature that call for the capabilities provided by these features.

(2) The Suitability of the G-15 to Business Data Processing Problems Has Been Improved, but Its Usefulness in this Area Is Still Limited

In an effort to increase the usefulness of the G-15 for dual engineering-scientific and business data processing applications, and thus expand its market, Bendix has added several important features. These include the CA-1 and CA-2 punched card input-output accessories and alpha-numeric data-handling capabilities. While enhancing the acceptability of the system to the user with limited data processing requirements, the G-15 is still not competitive in those instances where 50% or more of the work load is of a data processing nature. This limitation stems from the relatively slow speeds of the card-handling and magnetic tape units and the disadvantages of binary machine language for simple accounting-type problems.

(3) The G-15 Has Achieved Little Success in the Process Control Area

The G-15 is not wholly suited to process control applications because of its limited number of available input-output connections. The few sales that have been made in this area have been in support of tape controlled machine tool installations where the computer is used as a tape preparation device rather than as an on-line control unit.

2. THE COMPETITIVE SITUATION IN THE SMALL COMPUTER MARKET HAS BECOME MORE COMPLEX IN THE PAST THREE YEARS

An important consideration in the comparative evaluation of the G-15 is the environment in which it must compete. A number of significant changes have occurred since the design and introduction of this computer that have an important bearing on its current and future market potential. A few of the more important of these changes are discussed in the following points.

(1) Data Processing Needs as Applied to Small Computers Have Expanded

The small computer was initially most successful in engineering-scientific applications because of the pressure on technical centers for increased productivity with little or no increase in professional personnel. In addition, as pointed out in our 1957-1958 report, the economic motivation to use computers is greater in the scientific area than in business data processing, because of the basic labor rate differentials between technical personnel and clerks. As a result, organizations with a requirement for small E&S computers have been quick to recognize the need and obtain the necessary equipment.

In the meantime, two other developments have been taking place. The small E&S computer user has begun to branch out

in his applications, handling payroll, inventory control, and other typical business data processing problems in conjunction with his technical work. Whereas the computer was initially selected on the basis of its capabilities in the engineering-scientific area, increased dual utilization adds a requirement for the input-output and other features of the data processor.

Similarly, smaller companies have begun to look to small computers as a possible answer to their spiraling paper work loads and clerical labor costs. Thus, whereas three years ago, the scientific computer offered the greatest single market opportunity, recent shifts in consumer requirements indicate that a small computer with capabilities in both application areas offers the greatest opportunity. If only one capability can be provided in this class of machine, it would appear that it should be data processing, in order to tap the larger market.

(2) Modular Design and System Expansibility Have Become More Important

The trend in the computer industry is definitely to modular design and construction techniques. This has become apparent in all three equipment price classes and both application areas. The motivation to move in this direction stems from two sources: the widely varying needs of each individual computer user and the desire on the part of the manufacturer to be able to tailor his

equipment to as large a number of potential users as possible. There is no doubt that a number of G-15 "sales" have been lost that would have been made, if memory could be doubled through the addition of a module or input-output speeds doubled through the attachment of a slightly higher cost accessory. Bendix has recognized this trend and the requirement to satisfy it is reflected in the system expansibility that has been designed into the G-25 and G-20 systems.

(3) Transistorized Equipment Has Come on the Market

Probably the most significant event to occur since the introduction of the G-15 has been the recent shift from vacuum tubes to transistors and diodes, and rotating drum memories to ferrite cores. This change in components has permitted some far-reaching design changes that have a significant impact upon the speed and capabilities of the newer equipment.

In general, the newer, solid state computers have several distinct advantages from the operational and marketing viewpoints, as compared to earlier equipment. Some of these advantages are:

1. Solid state machines are more compact, use less electrical power, and require less cooling.

2. Solid state machines are somewhat more reliable. (Over-all reliability is increased only slightly, since mechanical input-output equipment remains the most important factor in over-all system reliability.)

3. Solid state machines use newer and more glamorous components, thereby giving them a strong psychological appeal.

4. Solid state machines that utilize core and acoustic delay line memories have no mechanical motion internally.

5. Solid state machines with magnetic core memories permit much faster access and faster internal computation.

The major advantages of the older vacuum tube machines are:

1. They are cheaper for an equivalent number of components.

2. They have full complements of programming aids which have been refined and perfected through the years.

3. The older machines have largely been "debugged" through actual operating experience - the new user is not leasing unproven and untried equipment.

Examination of the relative advantages of the two types or generations of equipment quickly shows that most of the advantages of the solid state machines are of a more enduring nature than are the advantages of the older machines. As the newer machines take their place in the market, program libraries will be developed and systems faults corrected. As this occurs, the current advantages of the vacuum tube machines will largely disappear.

The sole advantage remaining to the older equipment will lie in lower unit manufacturing costs. Since this cost represents only about 25% of the total purchase price of the equipment, it is considered unlikely that this will have much effect.

Thus, the only source of sales for the G-15 and its counterpart equipment lies in those instances where they offer greater capacity than an equivalent second generation machine for less cost. Though it is virtually impossible to appraise the suitability and economics of any given machine against the almost infinite variety of user requirements, the following discussion should assist in determining the relative position of the G-15 with respect to its current competition.

3. A COMPARISON OF THE FEATURES AND CAPABILITIES OF AVAILABLE EQUIPMENT INDICATES THAT THE G-15 IS NO LONGER OUTSTANDING IN ITS PRICE CLASS

Exhibits C-I, C-II, and C-III of this appendix present the major features and characteristics of small scale general purpose digital computers. From these characteristics, an impression of the computers' organization, capacities, and capabilities can be obtained. However, as pointed out earlier, final equipment selection seldom hinges on a single capability or characteristic. Rather, selection is usually made on the basis of what might be termed a weighted average of the various features and capabilities of each unit - the weighting being established by the nature of the prospective user's problems.

However, some general idea of the G-15's current competitive position can be obtained from a generalized comparison of its features with those being offered in competitive products.

APPENDIX C (9)

Exhibit C-I, following this page, reflects the general characteristics of the available small scale general purpose computers. The units have been listed from top to bottom in order of ascending monthly rental. The following explanations apply to each of the column headings:

Approximate Monthly Rental -
The prices listed are for typical useful systems. Often, features optional on some systems are part of the basic computer in other systems; therefore, the prices listed must be considered to be approximate estimates of relative costs. When a price range is provided, the lower price is for a basic system without magnetic tapes. The higher price indicates a complete system with magnetic tapes.

Application Orientation -
The listed classifications - "E&S" (engineering and scientific), "ADP" (automatic or business data processing) or "DUAL" (indicating an equivalent capability in both areas) - reflect the design and marketing orientation of the machine. However, this does not mean that certain units are not or cannot be used in other areas of application.

Components -
"S/S" indicates a second generation machine that utilizes transistors, diodes, and other "exotic" components. VT indicates a vacuum tube machine.

Modular Expansibility -
A "high" indicates that a large variety of components and peripheral equipment is available that can greatly increase the capacities and capabilities of the basic machine.

High-Speed Computer Compatibility -
When another machine of the same manufacturer is listed, it means that the larger, faster computer can accept programs written for the small one or that the two machines can directly communicate with each other.

EXHIBIT C-I
BENDIX CORPORATION

GENERAL CHARACTERISTICS OF THE G-15 AND COMPETITIVE SMALL COMPUTERS

Approximate Monthly Rental	Manufacturer	Model	Application Orientation	Components	Modular Expansibility	High Speed Computer Compatibility
700	Litton	Monrobot XI	E&S	S/S	Low	Nor
1,100	Royal Precision	LGP-30	E&S	VT	Low	None
1,200	Packard-Bell	PB-250	E&S	S/S	Low	None
1,500	Autonetics	Recomp III	E&S	S/S	Low	None
1,500	Control Data	CDC 160	ADP	S/S	High	CDC 1604
1,500	BENDIX	G-15	E&S	VT	High	None
1,600	IBM	1620	E&S	S/S	High	IBM 1401-1410
1,800	Royal Precision	RPC 4000	E&S	S/S	Low	None
2,200	Digital Equipment	PDP-1	E&S	S/S	Low	None
2,500	Royal Precision	RPC-9000	ADP	S/S	High	None
3,000	Autonetics	Recomp II	E&S	S/S	Low	None
2,500 - 8,000	IBM	1401	ADP	S/S	High	IBM 7000 Series
2,700 - 9,000	RCA	301	ADP	S/S	High	RCA 501-601
3,600	Electronics	ALWAC IIIE	E&S	VT	High	None
4,400	Digital Equipment	PDP-3	E&S	S/S	Low	Non
4,000 - 8,000	General Electric	GE 225	ADP	S/S	High	None
4,000 - 8,000	Burroughs	205	E&S	VT	High	None
4,000 - 9,000	IBM	650	Dual	VT	High	None
5,000 - 9,000	National Cash Register	NCR 315	ADP	S/S	High	None
7,000 - 9,000	Remington Rand	SS 80/90	Dual	S/S	High	None
8,700 - 12,000	Minneapolis-Honeywell	H-400	ADP	S/S	High	Honeywell 800

Examination of Exhibit C-I readily shows that a considerable amount of new G-15 competition has entered the market within the past two years. Essentially, the machines in this category are all solid state devices, eight of which are oriented to the scientific application area.

(1) Several of the New Machines Are Superior to the G-15 with Respect to Internal Characteristics

Exhibit C-II, following this page, lists the principal internal characteristics of the available computers. The following notes apply to the column headings shown:

Storage Capacity -
Number of words of addressable internal storage available.

Average Access Time -
Storage cycle time to complete one read or write of a word in millionths (U) or thousandths (M) of a second.

Word Size and Internal Notation -
The word size is the smallest group handled as an addressable unit. Internal notation indicates the manner in which information is handled within the machines.

Arithmetic Operations Available -
A "3" indicates that addition-subtraction, multiplication, and division are performed by circuitry. A "2" indicates that addition-subtraction and multiplication are performed by circuitry. A "1" indicates that only addition-subtraction is performed by circuitry. When arithmetic operations are not performed by circuitry, they have to be programmed.

EXHIBIT C-II
BENDIX CORPORATION

INTERNAL CHARACTERISTICS OF THE G-15 AND COMPETITIVE SMALL COMPUTERS

Model	Storage Type	Storage Capacity	Average Access Time Main	Average Access Time Fast	Word Size	Internal Notation	Arithmetic Operations Available	Internal Speed	Floating Point Arithmetic	In Registers
Monrobot XI	Drum	1,024	6.0m		32	Binary	3	Slow	No	0
RPC LGP-30	Drum	4,000	8.5m		31	Binary	3	Slow	No	0
PG 250	Delay line	1,800 - 16,000	1.5m	.09m	22	Binary	3	Medium	No	1
Recomp III	Disc	4,096	9.0m	.95m	40	Binary	3	Slow	No	0
CDC 160	Cord	4,000	6.4μ		12	Binary	1	Medium	No	0
BENDIX G-15	Drum	2,160	14.5m	.54m	29	Binary	3	Slow	No	0
IBM 1620	Core	20,000 - 60,000	20μ		1	Decimal	2	Medium	No	0
RPC 4000	Drum	8,192	8.5m		32	Binary	3	Slow	No	1
PDP 1	Core	1,024 - 4,096	5μ		18	Binary	1	Medium	No	0
RPC 9000	Delay line	72	.8m		12	Alpha	2	Slow	No	0
Recomp II	Disc	4,096	9m	.95m	40	Binary	3	Slow	Yes	
IBM 1401	Core	1,400 - 16,000	11.5μ		1	Alpha	1	Medium	No	
RCA 301	Core	10,000 - 20,000	7μ		1	Alpha	1	Medium	No	1
ALWAC IIIE	Drum	4,000 - 8,000	4.0m		33	Binary	3	Slow	No	1
PDP - 3	Core	4,096 - 32,768	5μ		36	Binary	2	Fast	No	511
GE 225	Core	4,096 - 16,384	18μ		20	Binary	3	Fast	Yes	3
Burroughs 205	Drum	4,080	8.5m	.85m	10	Decimal	3	Slow	Yes	1
IBM 650	Drum	1,000 - 4,000	2.4m	.1m	10	Decimal	3	Slow	Yes	3
NCR 315	Core	?	6μ			?	?	?	No	32
SS 80/90	Drum	4,096	1.7m	.4m	10	Decimal	3	Slow	No	3
M-H 400	Core	1,024 - 4,096	8μ		12	Decimal	3	Medium	No	3

Internal Speed -
Relative comparison based on arithmetic operations performed on normal length numbers. "Fast" speed indicates an add time of less than 100 microseconds; "medium" speed indicates an add time, in range from 100 to 1,000 microseconds; "slow" speeds indicate an add time greater than 1,000 microseconds. An add time is the time required to acquire and execute one add instruction.

Floating Point Arithmetic -
A "yes" means that floating point arithmetic is performed by circuitry rather than programming. When the operation is performed by programming, it is both more time-consuming and more memory-consuming.

Examination of the "access time" and "internal speed" columns readily shows the advantages offered by the newer solid state, core memory machines. These higher speeds result in significant increases in the computational capacity of the newer units - without a significant increase in price. Some of these increases are in the order of 10 to 1 over the G-15 and similar vacuum tube equipment.

(2) A Number of Computers Have Come on the Market That Offer Faster Peripheral Equipment than the G-15

Exhibit C-III, following this page, lists the peripheral equipment that is available to support the various computers evaluated in this appendix. The speeds that have been underlined are those that are equal to or faster than those offered with the Bendix G-15. Generally speaking, the higher speed peripheral equipment is associated with slightly more expensive computers.

EXHIBIT C-III
BENDIX CORPORATION

PERIPHERAL EQUIPMENT CHARACTERISTICS OF THE G-15 AND COMPETITIVE SMALL COMPUTERS

Model	Paper Tape Characters/Second Read	Paper Tape Characters/Second Punch	Punched Cards Cards/Minute Read	Punched Cards Cards/Minute Punch	Magnetic Tape Transfer Rate	Magnetic Tape Buffering	Printer Lines/Minute	Console Typewriter
Monrobot XI	20	20	15	15	-	-		I/O
RPC LGP 30	200	20	-	-	-	-	-	I/O
PB 250	300	110	-	-	2K	-	-	I/O
Recomp III	400	20	-	-	-	-	-	I/O
CDC 160	350	60	1,300	-	30K	-	1,000	I/O
BENDIX G-15	400	60	100	100	430	RC, WC	100	I/O
IBM 1620	150	15	250	125	-	-	150	I/O
RPC 4000	500	300	-	-	-	-	-	I/O
PDP 1	400	60	-	-	15K	RC, WC	-	I/O
RPC 9000	500	300	400	-	52K	RWC	1,000	I/O
Recomp II	400	20	-	-	-	-	-	I/O
IBM 1401	500	-	800	250	7K/62K	-	600	O
RCA 301	100	100	600	100	7.5K	RC, WC	600	-
ALWAC IIIE	200	60	100	100	21K	RC, WC	150	I/O
PDP-3	400	60	-	-	15K	RC, WC	-	I/O
GE 225	1,000	60	400	100	15K/55K	RWC	600	O
Burroughs 205	540	60	300	100	6K	-	150	I/O
IBM 650	60	-	250	250	15K	RC, WC	150	-
NCR 315	1,000	120	400	250	40K/60K	RWC	900	-
SS 80/90	-	-	600	150	25K	RC, WC	600	-
M-H 400	1,000	60	650	250	64K	RW	900	-

However, it is quite possible that future improvements or equipment additions will result in stronger competition from some of the lower priced units that have the capability of handling higher speed input-output but as yet do not have the required accessories.

As an aid in the interpretation of this exhibit, the following notes apply:

Magnetic Tape Transfer Rate -
The number of characters (six binary digits) per second transferred between magnetic tapes and computer.

Magnetic Tape Buffering -
Indicates the operations that can be performed simultaneously with magnetic tape operations. "RC" indicates reading and computing; "WC" indicates writing and computing; "RWC" indicates reading, writing, and computing.

Console Typewriter -
"I" indicates that one is available for input. "O" indicates that same one is available for output.

4. IN SUMMARY, THE MARKET LIFE OF THE G-15 MAY BE EXPECTED TO DECREASE RAPIDLY IN THE FACE OF COMPETITION FROM THE NEW SOLID STATE COMPUTERS

The introduction of the new solid state, modular computers such as the IBM 1620, Royal Precision 4000, Packard-Bell 250, and Digital Equipment Corporation's PDP-1 will greatly increase the competition for new installations and add to the pressure from technological and economic obsolescence on the already-installed G-15's. Little can

be done to the unit as it stands to prevent this situation from becoming progressively worse. Stopgap improvements, though possibly of short-term benefit, are limited in scope and significance by the basic design of the present machine. Thus, it would appear that the only means available to Bendix to protect its present position in the small computer market is through the development and introduction of a small scale machine with capabilities equal to or superior to the second generation equipment being offered by competition.

* * * * *

We have not attempted to conduct a detailed, model-by-model comparative evaluation of the G-15 in this appendix. It was felt that this has been adequately done by the technical information section of the Bendix marketing department. The comments presented here are merely intended to put the present situation with regard to the G-15 in its proper perspective. We feel that the changes in the needs of users and the equipment available to them are of sufficient magnitude to make it evident that Bendix must have a comparable second generation computer to remain fully competitive.

APPENDIX D

APPENDIX D (1)

COMPARATIVE TECHNICAL EVALUATION OF THE BENDIX G-20 COMPUTER

This appendix presents a relatively detailed hardware evaluation of the G-20 computer system as compared to systems currently on the market. The analytical method employed in this phase of our study effort is very similar to that used by the more sophisticated computer users. This method and the results presented in this appendix do not take into consideration other factors that may affect a prospect's ultimate system selection. Some of the more important of these "nonhardware related" decision elements are:

- The strength and effectiveness of the manufacturer's sales and service organization.
- The availability of required programs, programming aids, and training material.
- Rental or purchase inducements such as price discounting, free program conversion, two-shift operation on a one-shift rental basis, etc.
- The over-all image of the manufacturer for quality products, on-time delivery, and acceptable after-sale support.

Each of these considerations will affect the final selection of equipment by a specific prospect - the weighting of each factor varying from company to company. Since these are qualitative, rather than quantitative, decision elements, they have not been included in this portion of our analysis.

APPENDIX D (2)

The study upon which this appendix is based was a joint effort between our professional staff and a special "task force" of the Bendix computer division. Since all of the detailed supporting data remained with the Bendix group, the following discussion is limited to the highlights of our findings.

1. THE G-20 COMPETES DIRECTLY OR INDIRECTLY WITH 14 DIFFERENT COMPUTERS

The price range of a typical G-20 system extends from approximately \$15,000 to \$40,000 per month. Within this range, there are 12 modern, solid state digital computer systems: 135

Manufacturer	Model	
General Electric	GE 210	53
Remington Rand	UNIVAC III	78
Radio Corporation of America	RCA 501	98
International Business Machines	IBM 7070	
International Business Machines	IBM 7074	
Minneapolis-Honeywell	H-800	63 - 17
Control Data Corporation	CDC 1604	60
Philco	2000 (210)	19
Radio Corporation of America	RCA 601	5
Philco	2000 (211)	
International Business Machines	IBM 7080	71
International Business Machines	IBM 7090	40

In addition, there are two older vacuum tube-type machines that are competing to a limited extent as new equipment, but pose a significant threat as used computers at discounted prices. These are the:

International Business Machines	IBM 704
International Business Machines	IBM 709

The primary strength of these latter two units lies in their proven performance and extensive program libraries. These "pluses," augmented by a 70% and 80% discount respectively, permit them, under certain conditions, to compete on a relatively favorable basis with the newer units listed earlier.

2. SEVERAL ADDITIONAL MACHINES SHOULD BE EVALUATED AS SOON AS DATA BECOME AVAILABLE

Two new computers which were recently announced - the Remington Rand Univac 1107 and Sylvania 9400 - have not been included in this analysis because of the unavailability of adequate information pertaining to their characteristics, capabilities, and prices.

In addition, there are several rumors concerning new machines that may be announced in the very near future. The manufacturers concerned are:

Philco
Control Data Corporation
Burroughs

It is understood that these units will fall in the area that is competitive to the G-20. However, no additional data are available at this time. When information becomes available, the recently completed competitive hardware analysis should be updated accordingly.

3. THE RELATIVE MERITS OF COMPETITIVE COMPUTER SYSTEMS CAN BE MEASURED IN TERMS OF POWER OR CAPACITY AND EFFICIENCY OR WORK PERFORMED PER DOLLAR EXPENDED

The best measure of a particular electronic computer's capabilities is how well it performs in accomplishing the normal work load of the user. Obviously, this ideal is not possible, for each user's requirements vary and the opportunity to compare the efficiency of two or more computer systems under the same work load seldom occurs.

Therefore, in order to measure the relative merits of the competitive units and the G-20, each machine has been evaluated on its ability to solve various "typical" problems. In this instance, routines or types of operations that are common to a variety of scientific and business problems have been selected for study. Each of the computers under consideration has been programmed and the time to complete the required operation calculated on a "solution per unit of time" and "solutions per dollar" basis. These two measures reflect the comparative power or capacity of each unit and their relative efficiency in terms of work performed for each dollar of rental.

(1) A Standard Machine Configuration Was Established

In order to compare the various units on bases as nearly equivalent as possible, a standard machine configuration was selected. Each of the systems was assumed to consist of:

- Arithmetic unit with floating point hardware.
- 16,384 words or approximately 64,000 characters of storage.
- Control console with typewriter.
- Control buffer or similar unit.
- Eight high-speed magnetic tape units.
- On-line card reader.
- On-line card punch.
- On-line high-speed printer.

The rental values used in the remainder of this analysis are the sums of the manufacturers' list prices for each of the items shown. Both list and discounted prices have been used in the case of the IBM 704 and IBM 709, inasmuch as these systems are being marketed in this manner.

(2) <u>The Operations Performed by a Computer System Were Examined To Determine Their Importance in Each Application Area</u>

The two major tasks associated with all computing and data processing problems are input-output and internal operations. Most of the newer systems are buffered so that these operations can be performed simultaneously. The one situation that places a strain on input-output and internal operations occurs in data

sorting and file updating problems. These tasks have been considered separately in order to obtain an indication of each system's capabilities when used for this purpose.

In addition to buffering, several of the newer systems possess the ability to solve several problems simultaneously on an interrupt basis. This ability is provided in the Bendix G-20 by the control buffer and communication lines. It has not been considered in this study, because the full significance of this development has not been established under normal operating conditions.

The internal operations that are performed in a modern computer can be divided into four main categories:

Arithmetic operations - time spent by the arithmetic unit in doing useful and necessary arithmetic.

Data-handling operations - time spent moving data from one storage location to another and in rearranging and modifying the data.

Housekeeping operations - counting of iterations, modifying and constructing addresses, and determining what is to be done next.

Storage accesses - time spent in transferring the instructions from storage to the control unit and the time spent transferring operands and partial results to and from storage.

The relative capacity and efficiency of each of the computer systems considered to be competitive to the G-20 are examined in the following points.

4. THE INTERNAL OPERATIONS OF THE G-20 ARE RELATIVELY POWERFUL AND EFFICIENT FOR A COMPUTER IN ITS PRICE CLASS

Each of the four key internal operating characteristics of the G-20 and its competitors has been measured and reduced to an index value relative to the G-20. These data are presented in graphical form on the following pages, along with a discussion pertaining to the method of measurement employed in each case. Exhibit D-I, following this page, is typical of the other exhibits to follow. A few moments of study will aid in the interpretation of the remainder of this evaluation.

(1) Capacity and Efficiency Are a Function of the Machine's Ability To Perform Simple Operations

In engineering and scientific applications, the most important operations in terms of time consumed are, in general, the arithmetic operations, housekeeping operations, and storage accesses. In addition, some problems require extensive input-output operations, but these are not considered typical.

Based upon the work of John Von Newmann and H. H. Goldstein,[1] it has been assumed that the speed of internal computation is directly proportional to storage access time, addition time, and

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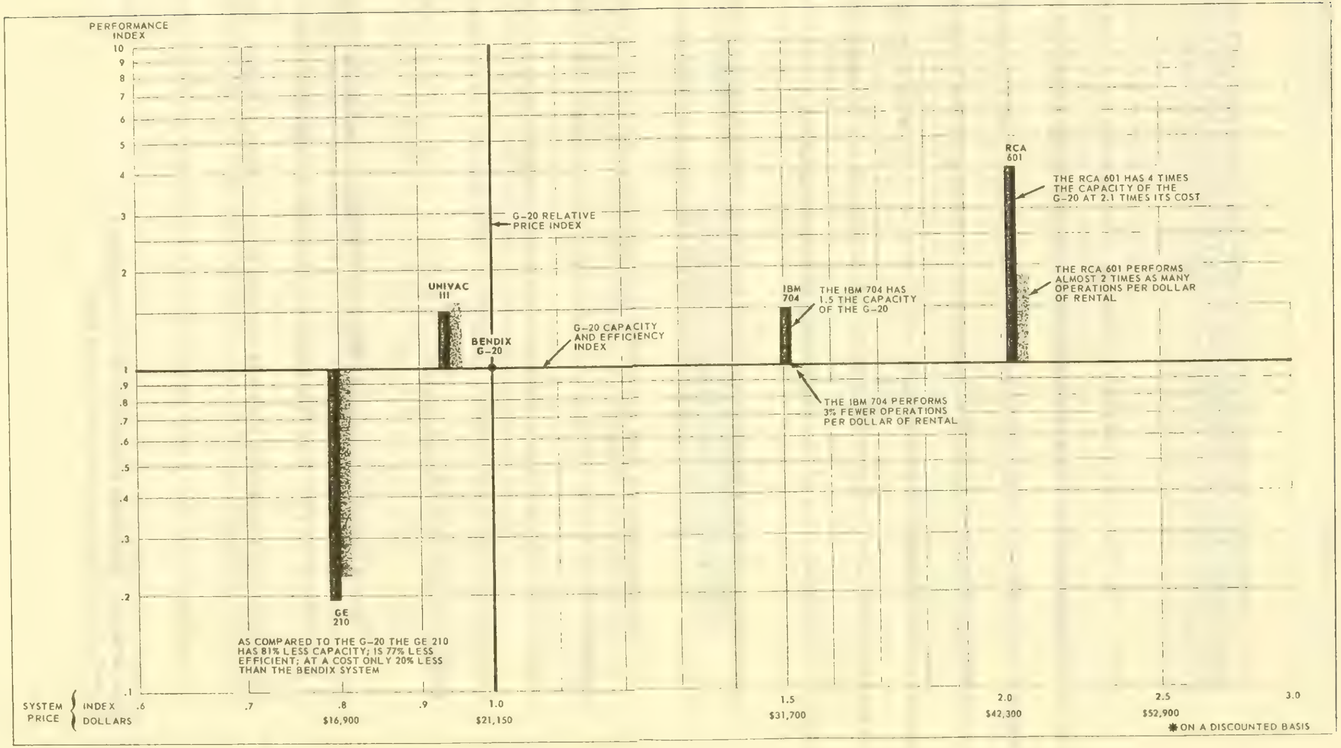
[1] H. H. Goldstein: "Systematics of Automatic Electric Computers." Proceedings of the Darmstadt Colloquium, October 1955.

EXHIBIT D I
BENDIX CORPORATION

EXAMPLE SYSTEM COMPARISON



multiplication time.[2] Each of these operations is shown in Exhibits D-II, -III and -IV, following this page.

(2) <u>Housekeeping Operations Were Evaluated on the Basis of a Computer's Ability To Perform an Iterative Routine</u>

The internal arithmetic and memory access operations considered above are common to all engineering and scientific problems, and many data processing-type problems. However, the above method does not show the relative ability of the various systems in terms of their power and efficiency in handling internal "housekeeping" operations. This capability can best be evaluated by considering a problem that requires extensive use of this nonarithmetic task.

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(2)Consider that the times required for arithmetic, "housekeeping" and storage access operations are additive. Then, as pointed out in reference 1, the time required for solving a problem may be written as:

$$T = KMN$$

where,

N = number of multiplications
M = multiplication time (exclusive of access time)
K = constant for each machine and problem

This formula is based upon the assumption that, on the average, each multiplication is imbedded in a sequence of $(A + 1)$ instructions consisting of one multiplication and A nonmultiplicative instructions, each of which takes an average time L to execute. The time to execute these instructions is then:

$$t = M + AL + (A+1)(a_i + a_o)$$

where,

a_i = instruction access time
a_o = operand access time

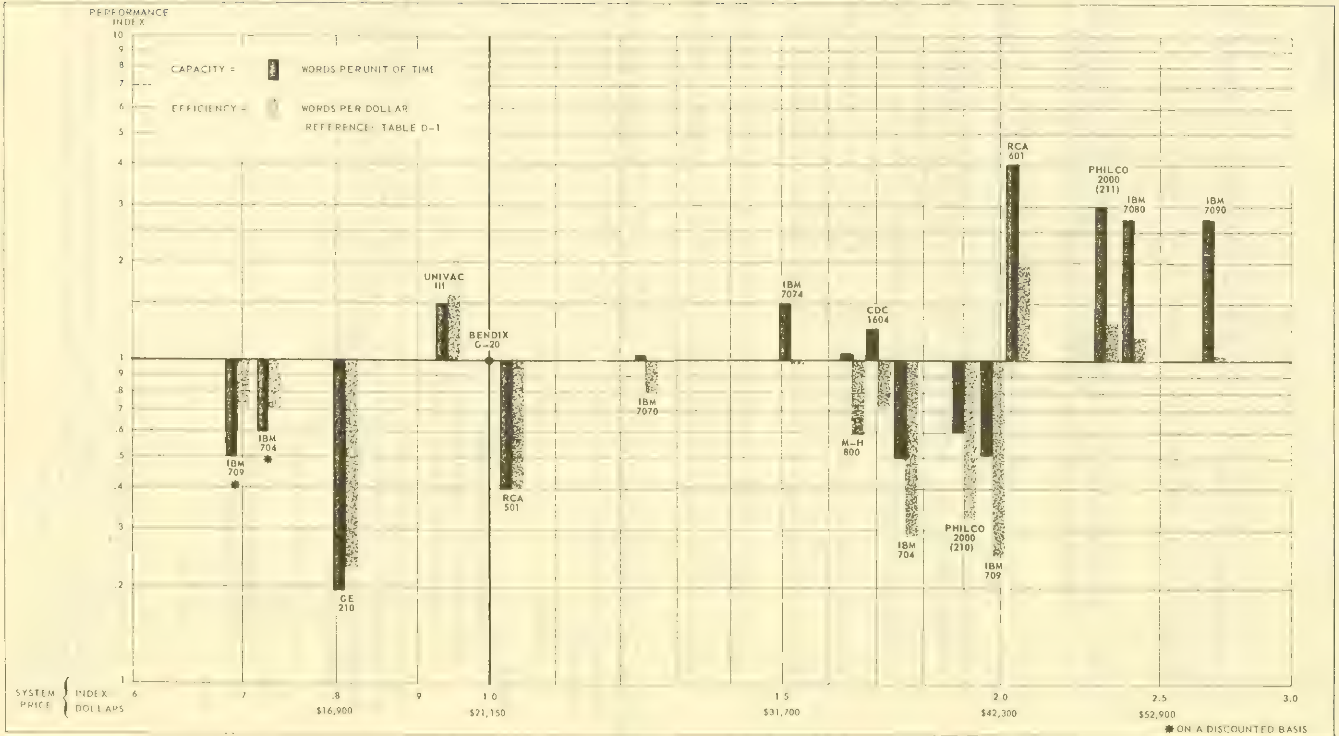
then,

$$T = Nt = KMN$$
$$K = \frac{t}{M}$$
$$K = 1 + \frac{AL}{M} + \frac{(A+1)(a_i + a_o)}{M}$$

If we assume that the average time to execute an instruction (L) is directly proportional to addition time, then the speed of internal computation is directly proportional to storage access times, addition times, and multiplication times.

EXHIBIT D II
BENDIX CORPORATION

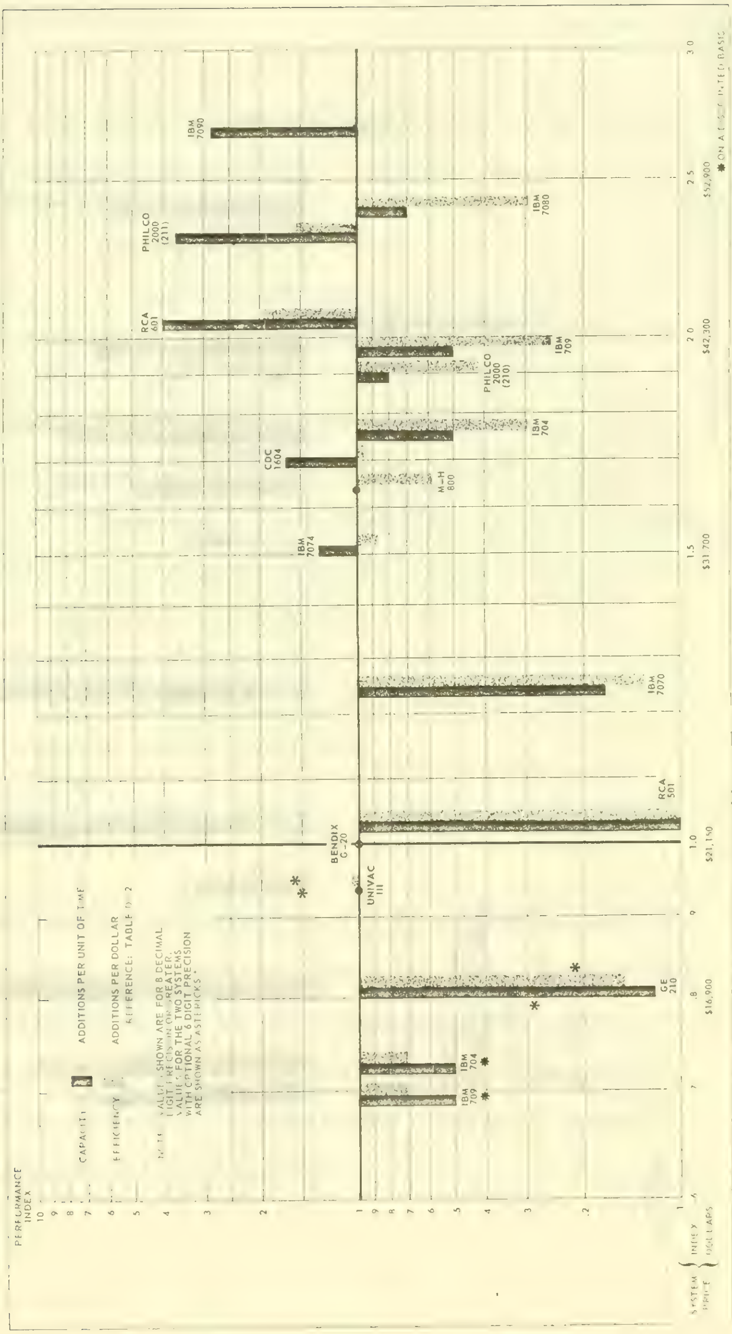
INTERNAL OPERATIONS - MEMORY ACCESS (WORDS)



BENDIX CORPORATION

INTERNAL OPERATIONS: FIXED POINT ADDITION

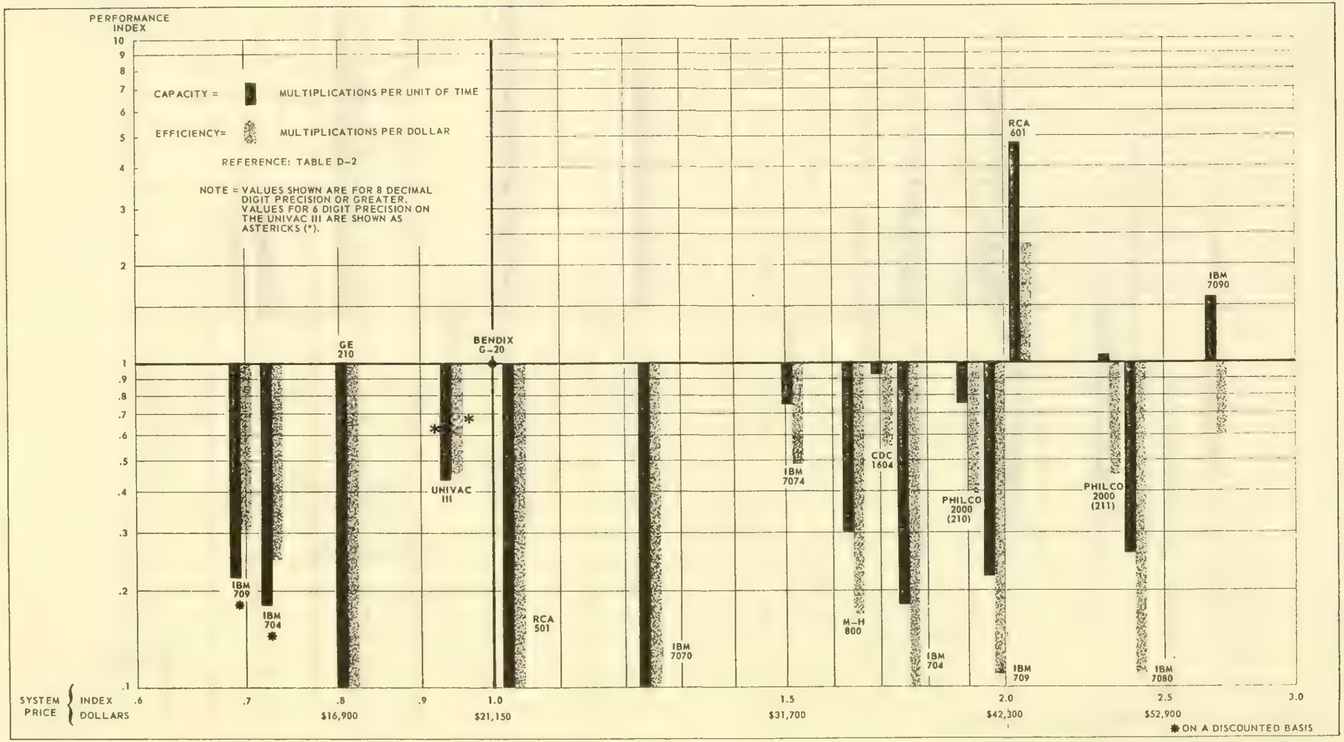
A + B → ACCUMULATOR



EX...BIT D IV
BENDIX CORPORATION

INTERNAL OPERATIONS FIXED POINT MULTIPLICATION

A x B ——→ ACCUMULATOR



In the engineering and scientific application areas, problems that fit these requirements are:

- Matrix inversions
- Solution of sets of linear equations
- Integration of partial differential equations

The number of instructions contained in the iterative procedures or "inner loops" involved in each of these is highly variable. However, all of them require the "housekeeping" operations of counting iterations, constructing and modifying addresses, and determining what to do next (testing and control).

The following problem was selected as representative of this particular machine requirement.

$$\text{Sum} = \sum_{i=1}^{1000} (A_i \times B_i + C_i + D_i)$$

It has been programmed and timed in both floating point and fixed point form. A minimum level of precision of eight decimal digits was assumed to be necessary for most engineering and scientific problems. However, the six-digit floating point form possible with the G-20 was also evaluated and is shown in the supporting tables at the end of this appendix.

Exhibits D-Vand VI, following this page, show the comparative results of this analysis for the fixed and floating point form. Four machines are not shown on the floating point exhibit; three must be programmed and are, thus, not competitive in this instance, and the fourth, or Univac III, could not be evaluated for lack of the necessary data.

5. THE INPUT-OUTPUT CAPABILITIES OF THE G-20 - THOUGH GOOD - ARE NOT AS OUTSTANDING AS ITS INTERNAL SPEEDS

The G-20 is primarily directed toward the engineering-scientific field, and, as such, requires superior internal operating capacity and efficiency. However, data processing and E&S applications are becoming increasingly intermixed; dual usage is becoming more the rule than the exception. In an effort to appraise the G-20's relative competitive position as a data processor, two capabilities have been examined: internal data handling and merge-sort operations.

(1) Internal Data Handling Is Somewhat Slower than the Better Competitive Machines

In data processing operations, both input-output and internal data-handling capabilities are important. In general, arithmetic operations are not as important as they are in engineering-scientific work. As an indication of a given computer's internal data-handling

EXHIBIT D A
BENDIX CORPORATION

INTERNAL OPERATIONS: FIXED POINT SUMMATION, 8 DIGITS OR MORE

$$\text{SUMMATION} = \sum_{i=1}^{1,000} (A_i \times B_i + C_i + D_i)$$

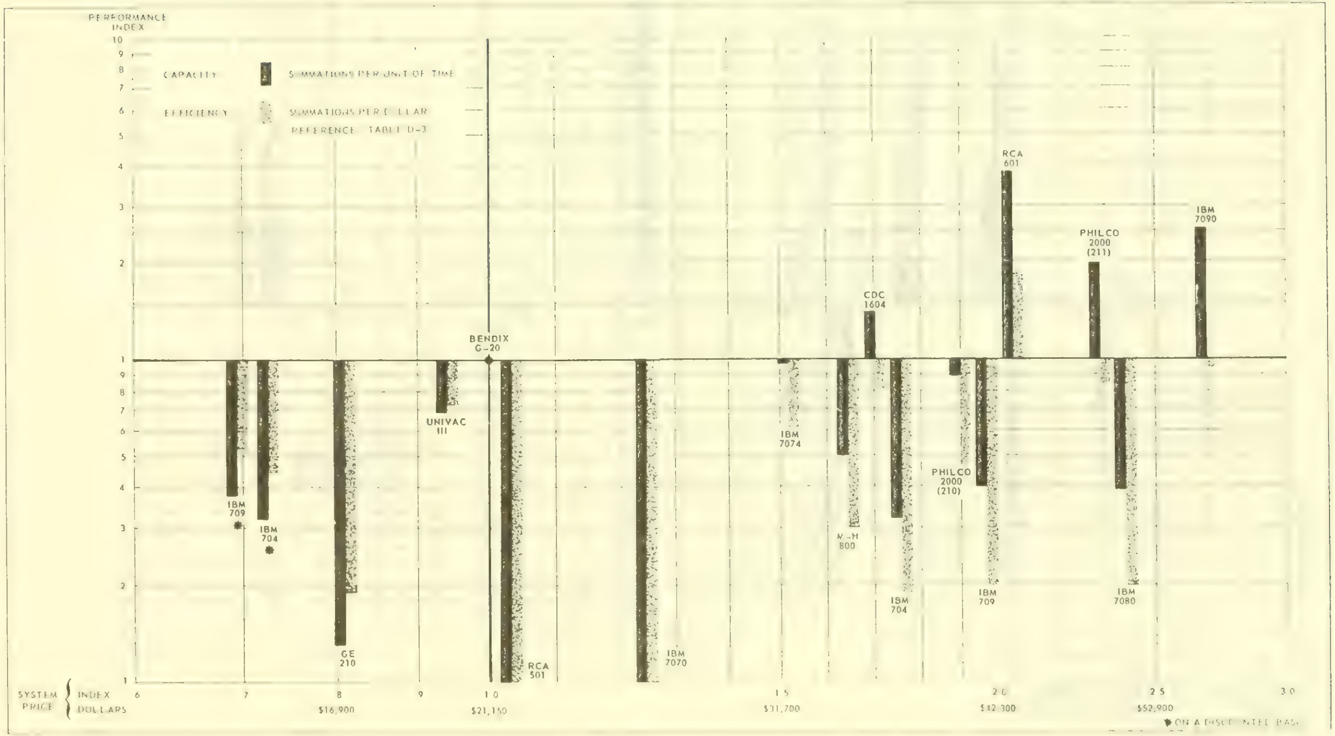
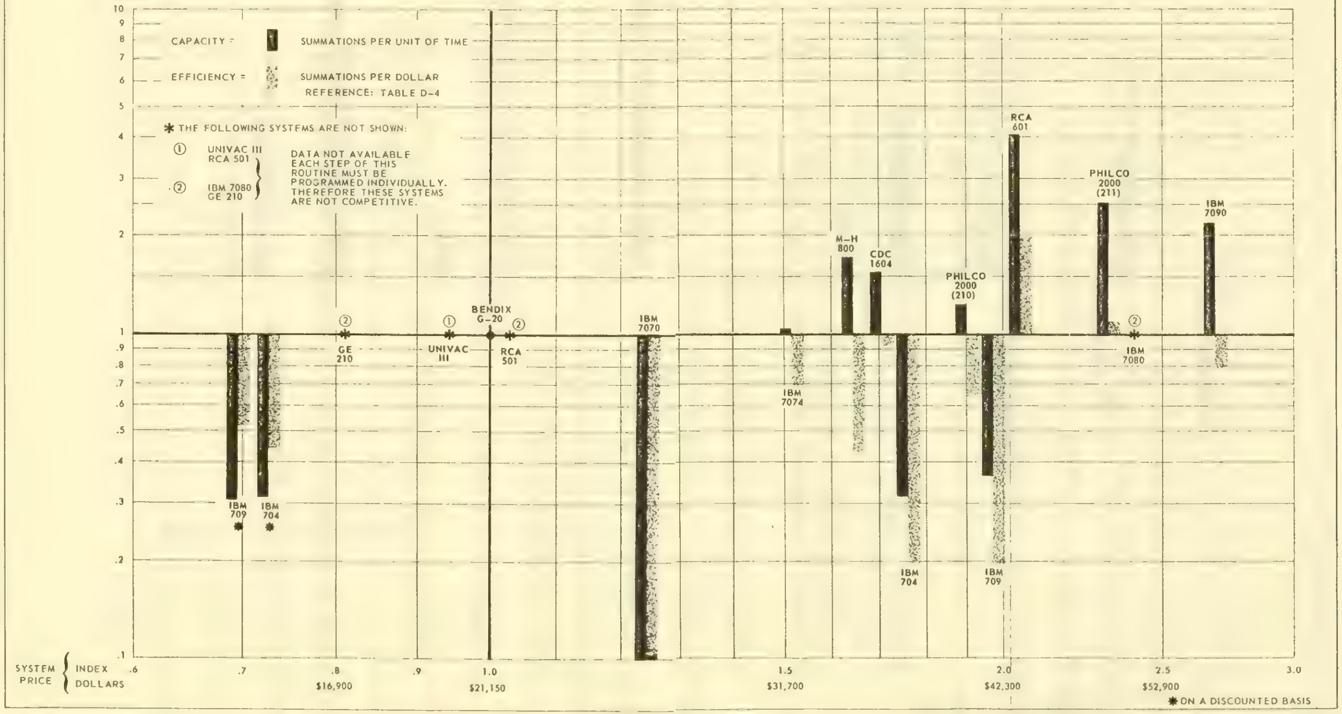


EXHIBIT D VI
BENDIX CORPORATION

INTERNAL OPERATIONS: FLOATING POINT SUMMATION; 8 DIGIT PRECISION

$$\text{SUMMATION} = \sum_{i=1}^{1,000} (A_i \times B_i + C_i + D_i)$$



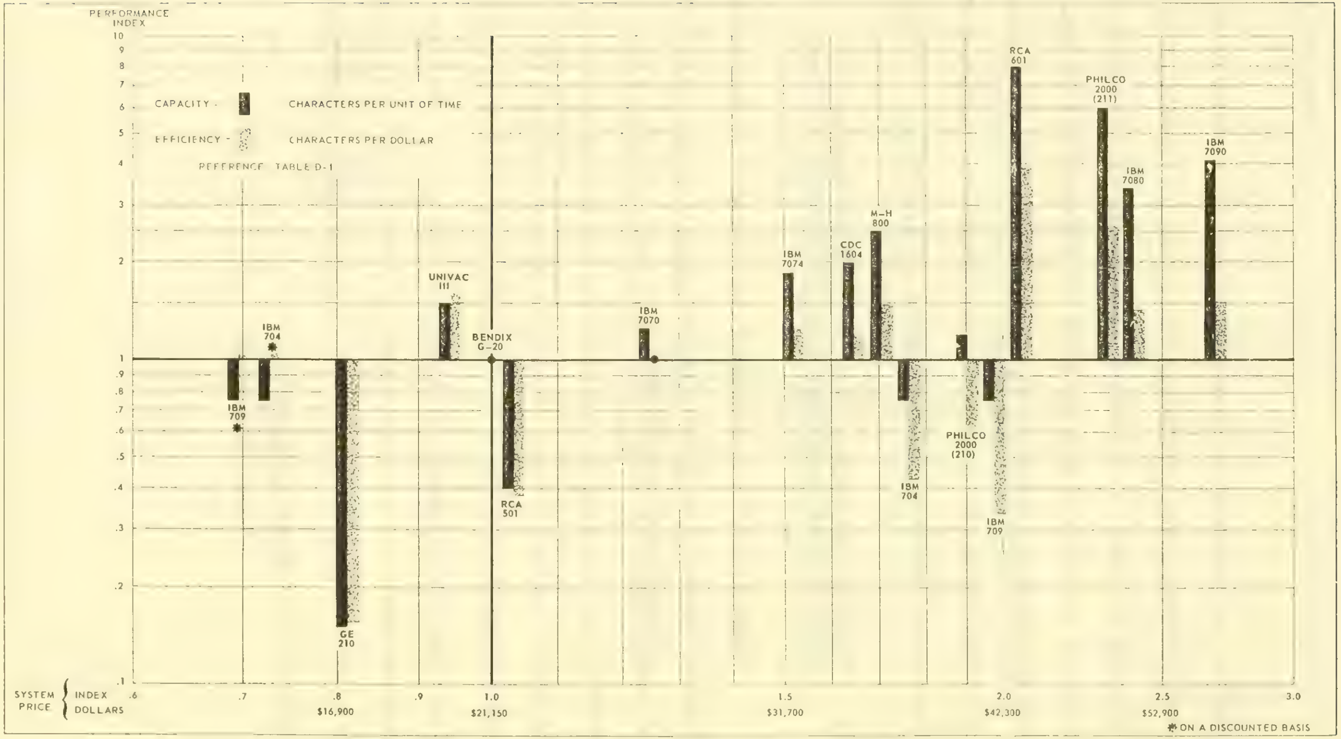
abilities, an evaluation of the number of characters available per memory access was performed and is presented as Exhibit D-VII, following this page. This characteristic and the ability to transfer blocks of data (greater than one word) are indicative of a machine's data processing capabilities. These operations are very important in sorting, file maintenance, and report preparation routines where large quantities of data are consistently being moved and modified.

(2) The Pending Change in Tape Specifications Reduces the G-20's Sorting Capabilities from "Outstanding" to "Good"

Merge-type sorting on magnetic tape is one of the best indications available of a machine's input-output capabilities. In this type of sorting, extensive use is made of the system's magnetic tape facilities by continually moving data from tape through the central processor and back to tape. Because of the buffering associated with present-day computers, it is possible to perform these three operations simultaneously. Normally, the reading and writing of magnetic tape is the most time-consuming element of this process. In an effort to appraise the G-20 as a data processor, the following merge-sort problems were employed:

EXHIBIT D VII
BENDIX CORPORATION

INTERNAL OPERATIONS: MEMORY ACCESS-CHARACTERS



1. 10,000 records, 200 characters per record, 20 character key

2. 40,000 records, 400 characters per record, 20 character key

Assumptions:

- 6 magnetic tape units
- 60,000 character internal memory capacity

The results of this evaluation are presented as Exhibits D-VIII and -IX. The indexes shown are based on G-20's originally published tape specifications. The improved relative performance of the competitive equipment, based on the pending change in G-20 tape performance, is also shown.

It can readily be seen that the tremendous increase in start time for the writing operation greatly reduces the effective speed of the G-20 magnetic tape units. Under the original 5 millisecond start-stop time, the G-20 was better in merge-sort operations than all competitive systems except the RCA 601 on a capacity and efficiency basis. The pending change from 5 millisecond to 25 millisecond start-write time will place the G-20 at a competitive disadvantage with respect to the Univac III, Honeywell 800, Philco 2000 (Models 210 and 211), and the RCA 601. This is particularly important, in that it gives the Univac III a 2.5 to 1 advantage over the G-20, with the former being a lower priced system.

EXHIBIT D VIII
BENDIX CORPORATION

DATA PROCESSING FUNCTIONS:
MERGE-SORT; 10,000 RECORDS

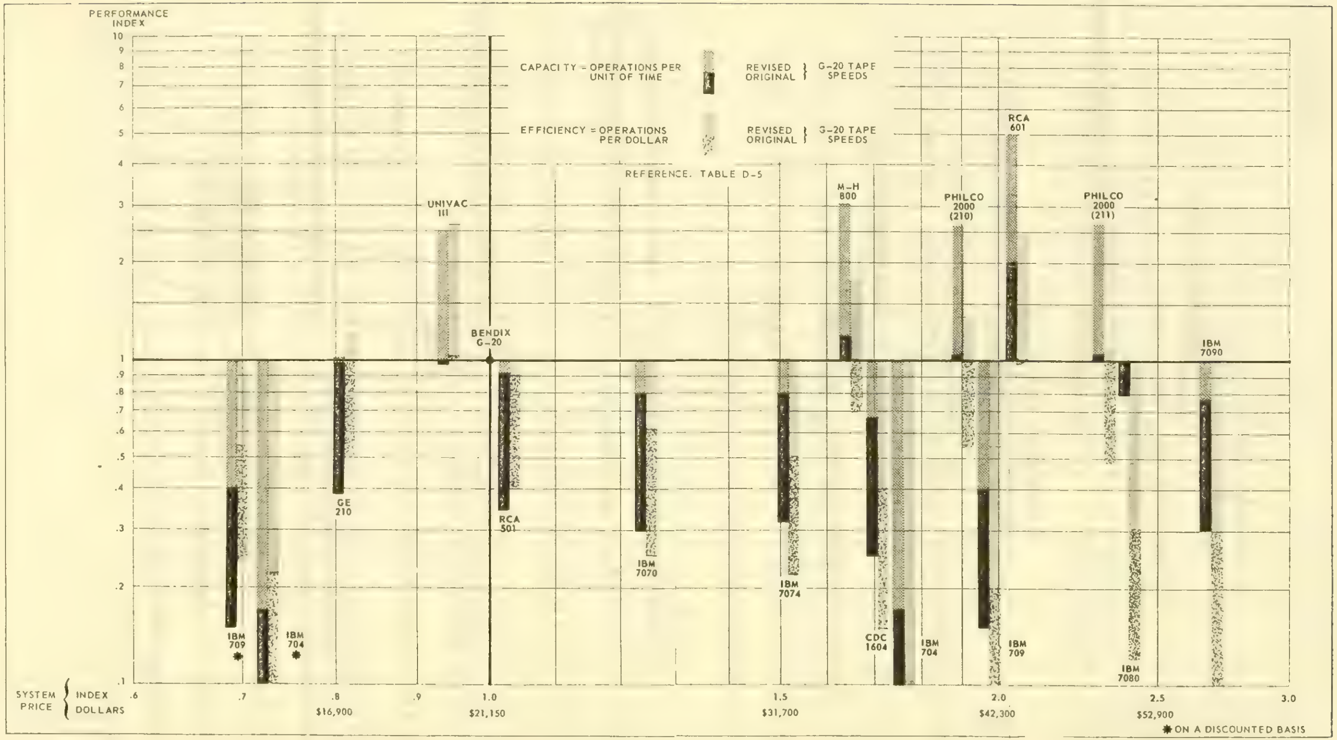
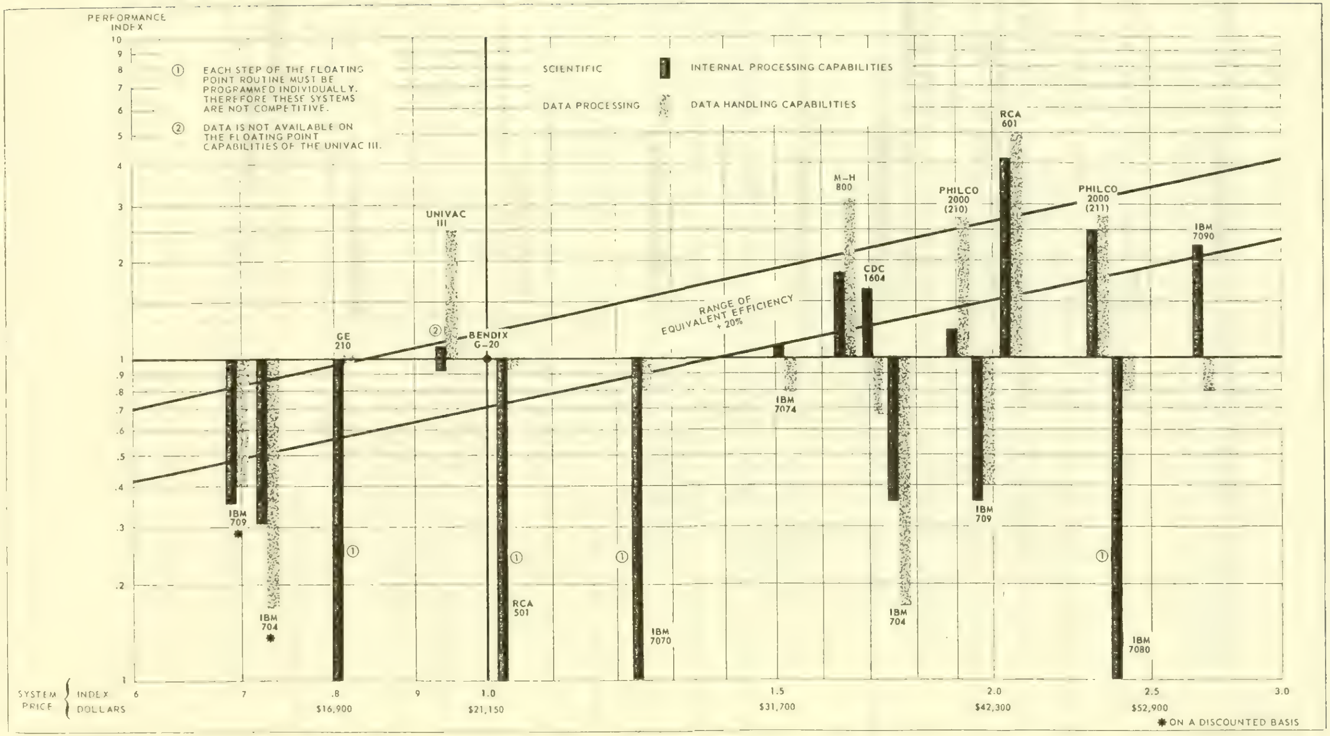


EXHIBIT D X
BENDIX CORPORATION

RELATIVE COMPETITIVE POSITION OF THE BENDIX G-20



6. THE G-20 IS AMONG THE BEST COMPUTERS ON THE MARKET TODAY

A number of individual machine characteristics and capabilities have been evaluated on the preceding pages. Of these, two are reasonably indicative of a specific computer's capabilities in engineering and scientific applications and in data processing applications. For scientific, the floating point summation problem shown in Exhibit D-VI and for data processing, the merge-sort problem shown in Exhibit D-VIII.

The relative indexes for each of these problems are shown on Exhibit D-X, following this page. This chart differs slightly from the preceding nine, in that system capacity is plotted against the system price index. The efficiency index (capacity per dollar of rental), is not shown as a bar for each computer, but as a range of equivalent efficiency to the G-20. In effect, this range shows what the capacity should be relative to system price for a unit equally efficient as the G-20. A range of plus or minus 20% has been used, since we do not believe the average consumer would go into as detailed an analysis as this one and thus would not place much emphasis on relatively small degrees of difference in efficiency.

The second major difference between this and the preceding exhibits is that each system is represented by two bars, one showing its capacity in the engineering-scientific area (as reflected by its

capabilities in the solution of the floating point summation problem) and the other in the data processing area (as reflected by its capabilities in the 10,000 record merge-sort problem).

The significance of this exhibit lies in the relative positions of the various equipments. First, consider the four quadrants:

The Upper Left: Systems that fall within this quadrant have capabilities equal to or better than the G-20 at a price equal to or less than the Bendix system.

The Upper Right: These systems have capacity equal to or greater than the G-20 and an equivalent or higher price.

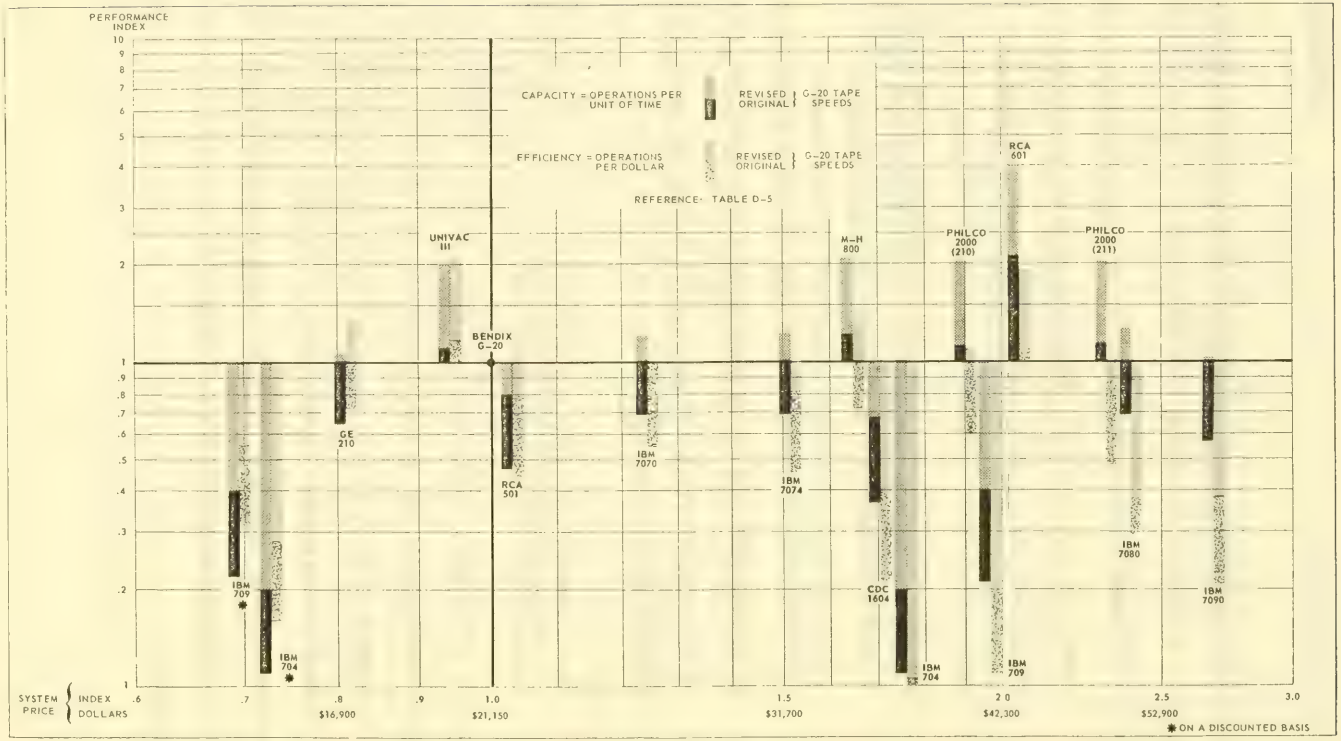
The Lower Right: Here, we find systems with capacity equal to or less than the G-20, but at a higher price.

The Lower Left: This quadrant contains systems with lower capacity and at a lower price than the Bendix system.

Next, consider the range of equivalent efficiency. Systems that fall below the lower limit of this range provide more than 20% less capacity per dollar of rental than the Bendix system. Those above the upper limit perform 20% or more operations per dollar than the G-20. The systems within this range are approximately equal (± 20%) to the G-20 in efficiency, though capacity may be higher or lower. Examination of this exhibit brings forth several significant conclusions relative to the competitive position of the Bendix G-20 in terms of its price and capabilities.

EXHIBIT IX
BENDIX CORPORATION

DATA PROCESSING FUNCTIONS.
MERGE SORT - 40,000 RECORDS



(1) Of the Sixteen Systems with Which It Competes, the G-20 Faces Strong Hardware Competition from Only Five in Engineering-scientific Applications

Only five competing systems offer equivalent value to the G-20. These are the Honeywell 800, CDC 1604, RCA 601, Philco 2000 (Model 211), and the IBM 7090. Each of these systems offers 50% or more capacity at a relatively higher price. The RCA 601 stands out as the best value in the group, with the Philco, Honeywell, and Bendix systems running second.

Within a price range of 50% either way, the Bendix system is the best value and offers the highest capacity of any computer on the market. The possible exception to this may be the Univac III, which is not shown for lack of data.

(2) In Data Processing Applications, the G-20 Faces Strong Competition from Seven Systems

The most serious threat to the G-20 in this area appears to be the Univac III, for it offers almost two and a half times the capacity of the G-20 at a price 5% lower. The GE 210 would be the second contender, in that it offers the same capacity at a 20% lower price, while the RCA 501, though of about the same capacity, is approximately 5% more expensive.

Among the units with higher data processing capacity than the G-20, the Honeywell 800, Philco 2000 (Models 210 and 211), and the RCA 601 stand out as equal or better values than the Bendix system.

(3) In Dual Applications, Serious Competition May Be Expected from About Three Systems, All Higher Priced than the G-20

There appear to be only three other systems that offer equivalent value to the G-20 in both types of applications, those requiring fast internal computation and those requiring extensive data handling and input-output. These systems are the Honeywell 800, RCA 601, and Philco 2000 (211), and probably the Univac III.

(4) These Conclusions - Though Indicative of Relative Hardware Capabilities - Should Be Kept in Their Proper Perspective

This evaluation has only taken into consideration each system's ability to perform a series of arbitrarily selected operations and problems. Those selected may not be in any respect similar to the requirements of a specific prospect or user. Every effort has been made to select "typical" computer requirements, but in truth, relatively few "typical" situations exist.

This evaluation also does not reflect simplicity of programming, availability of programs and routines, or the manufacturer's

service. Each of these has a bearing on final equipment selection. Partial proof of this fact is evident from the acceptance of IBM products in the market place, in the face of their poor showing throughout this "hardware" comparison.

The tables following this page present the detailed supporting data from which this analysis and Exhibits D-I through D-X were developed.

* * * * *

This appendix has presented a comparative technical evaluation of the Bendix G-20 against the 16 computers with which it competes. In a sense, this evaluation was conducted in a vacuum, in that the capabilities of each of the units were considered purely on the basis of performance and price - the criteria that the sophisticated user would select as a measure of the most economical unit for his needs.

Appendix E, which follows, presents a brief summary of the responses obtained from a selected group of computer users in various industries and areas of the United States.

TABLE D-1
STORAGE ACCESS INDEXES

System	Monthly Rental	Memory Cycle (μs)	Accesses per Second	Capacity Index	Accesses per Second per Dollar	Efficiency Index	Words or Information per Access	Characters per Access	Characters per Second	Capacity Index	Characters per Second per Dollar	Efficiency Index	Storage-to-Storage Record Transfer Instruction
IBM 709 (university discount)	$15,000	12.0	83,333	50	5.56	71	36 bits	6	499,998	75	33.33	106	No
IBM 704 (70% discount)	15,000	12.0	83,333	50	5.56	71	36 bits	6	499,998	75	33.33	106	No
GE 210	17,160	32.0	31,250	19	1.82	23	6DD	3	93,750	14	5.46	17	No
UNIVAC III	19,900	4.0	250,000	150	12.56	159	25 bits	4	1,000,000	150	50.25	159	No
BENDIX G-20	21,150	6.0	166,667	100	7.88	100	32 bits	4	666,668	100	31.52	100	No
RCA 501	21,740	15.0	66,667	40	3.07	40	1 or 4 alpha	4	266,668	40	12.27	39	Yes
IBM 7070	26,550	6.0	166,667	100	6.28	.80	10DD	5	833,335	125	31.39	100	Yes
IBM 7074	32,100	4.0	250,000	150	7.79	99	10DD	5	1,250,000	188	38.94	124	Yes
HONEYWELL 800	35,915	6.0	166,667	100	4.64	59	48 bits	8	1,333,336	200	37.12	118	Yes
CDC 1604	36,000 (approx.)	4.8	208,100	125	5.78	73	48 bits	8	1,664,800	250	46.24	147	No
IBM 704	36,650	12.0	83,333	50	2.27	29	36 bits	6	499,998	75	13.64	43	No
PHILCO 2000 (210)	40,100	10.0	100,000	60	2.49	32	48 bits	8	800,000	120	19.95	63	No
IBM709	42,400	12.0	83,333	50	1.97	25	36 bits	6	499,998	75	11.79	37	No
RCA 601	43,175	1.5	666,667	400	15.44	196	56 bits	8	5,333,336	800	123.53	392	Yes
PHILCO 2000 (211)	49,650	2.0	500,000	300	10.07	128	48 bits	8	4,000,000	600	80.56	256	No
IBM 7080	50,850	2.2	458,000	275	9.01	114	1 or 5 alpha	5	2,290,000	344	45.03	143	Yes
IBM 7090	57,400	2.2	458,000	275	7.98	101	36 bits	6	2,748,000	412	47.87	152	No

TABLE D-2
FIXED POINT ARITHMETIC INDEXES

System	Price Index	Fixed Point Addition: A + B → Acc. (μs)	Decimal Equivalent Precision	Additions per Second	Capacity Index	Additions per Second per Dollar	Efficiency Index	Fixed Point Multiplication: A x B → Acc. (μs)	Decimal Equivalent Precision	Multiplications per Second	Capacity Index	Multiplications per Second per Dollar	Efficiency Index
IBM 709 (university discount)	71	48.0	11	20,833	50	1.39	71	213.6	11	4,682	23	.31	31
IBM 704 (70% discount)	71	48.0	11	20,833	50	1.39	71	264.0	11	3,787	18	.25	25
GE 210	81	128.0	6	7,813	19	.46	23	614.0	6	1,629	7.8	.09	1
GE 210	81	192.0	12	5,208	13	.30	15	Not available*	12				
UNIVAC III	94	16.0	6	62,500	150	3.14	159	76	6	13,158	63	.66	67
UNIVAC III	94	24.0	12	41,667	100	2.09	106	110.0	12	9,091	44	.46	46
BENDIX G-20	100	24.0	8	41,667	100	1.97	100	48.0	8	20,833	100	.99	100
RCA 501	103	480.0	8	2,083	5	.10	5	15600.0	8	64	0.3	.003	0.3
IBM 7070	125	144.0	8	6,944	17	.26	13	996.8	8	1,003	5	.04	4
IBM 7074	152	18.0	8	55,556	133	1.73	88	64.0	8	15,625	75	.49	49
HONEYWELL 800	170	24.0	11	41,667	100	1.16	59	162.0	11	6,172	30	.17	17
CDC 1604	170	14.4	14	69,444	167	1.92	97	51.6	14	19,379	93	.54	55
IBM 704	173	48.0	11	20,833	50	.57	29	264.0	11	3,787	18	.10	10
PHILCO 2000 (210)	190	30.0	14	33,333	80	.83	42	64	14	15,625	75	.40	40
IBM 709	200	48.0	11	20,833	50	.49	25	213.6	11	4,682	23	.11	11
RCA 601	204	6.0	11	166,667	400	3.86	196	10.0	11	100,000	480	2.32	234
PHILCO 2000 (211)	235	6.5	14	153,846	370	3.10	157	45	14	22,222	107	.45	45
IBM 7080	240	34.0	8	29,412	71	.58	29	183.0	8	5,464	26	.11	11
IBM 7090	271	8.72	11	114,943	276	2.00	102	29.7	11	33,670	162	.59	60

*The information required to develop this time was not available.

TABLE D-3

FIXED POINT SUMMATION PROBLEM INDEXES

	Fixed Point						
System	Price Index	Summation Problem (ms)	Decimal Equivalent Precision	Problems per Hour	Capacity Index	Problems per Hour per Dollar	Efficiency Index
IBM 709 (university discount)	71	337	11	10,682	39	.71	54
IBM 704 (70% discount)	71	408	11	8,824	32	.59	45
GE 210	81	1,030	6	3,495	13	.20	15
UNIVAC III	94	132	6	27,273	99	1.37	105
UNIVAC III	94	190	12	18,947	68	.95	73
BENDIX G-20	100	130	8	27,692	100	1.31	100
RCA 501	103	17,734	8	203	1	.01	1
IBM 7070	125	1,392	8	2,586	9	.10	08
IBM 7074	152	136	8	26,471	96	.82	62
HONEYWELL 800	170	258	11	13,953	50	.39	30
CDC 1604	170	92	14	39,130	141	1.09	83
IBM 704	173	408	11	8,824	32	.24	18
PHILCO 2000 (210)	190	148	14	24,324	89	.61	47
IBM 709	200	337	11	10,682	39	.25	19
RCA 601	204	34	11	105,882	382	2.45	187
PHILCO 2000 (211)	235	65.8	14	54,711	198	1.10	84
IBM 7080	240	344	8	10,465	38	.21	16
IBM 7090	271	51	11	70,588	255	1.23	94

TABLE D-4
FLOATING POINT SUMMATION PROBLEM INDEXES

System	Price Index	Summation Problem (ms)	Decimal Equivalent Precision	Problems per Hour	Capacity Index (a)	Capacity Index (b)	Problems per Hour per Dollar	Efficiency Index (a)	Efficiency Index (b)
IBM 709 (university discount)	71	473.0	8	7,611	29	37	.51	42	53
IBM 704 (70% discount)	71	528.0	8	6,818	26	33	.45	37	46
GE 210	81	Programmed							
UNIVAC III	94	Data not available							
BENDIX G-20	100	139.0	6 (a)	25,899	100	-	1.22	100	-
BENDIX G-20	100	176.0	12 (b)	20,455	-	100	.97	-	100
RCA 501	103	Programmed							
IBM 7070	125	2526.0	8	1,425	6	7	.07	4	5
IBM 7074	152	166.0	8	21,687	84	106	.68	56	70
HONEYWELL 800	170	242.0	12	14,876	57	73	.41	34	42
CDC 1604	170	111.2	10	32,374	125	158	.90	74	93
IBM 704	173	528.0	8	6,818	26	33	.19	66	20
PHILCO 2000 (210)	190	142.0	10	25,352	98	124	.63	52	65
IBM 709	200	473.0	8	7,611	29	37	.18	15	19
RCA 601	204	43.0	11	83,721	323	409	1.94	159	200
PHILCO 2000 (211)	235	68.4	10	52,632	203	257	1.06	87	109
IBM 7080	240	Programmed							
IBM 7090	271	79.0	8	45,570	176	223	.79	65	81

TABLE D-5
SORTING PROBLEM INDEXES
(10, 000 Records)

System	Price Index	Time Required (min.)	1000 x Sorts per Day	Capacity Index (a)	Capacity Index (b)	Sorts per Day per Dollar	Efficiency Index (a)	Efficiency Index (b)
IBM 709 (university discount)	71	25.0	57,600	16	40	3.84	23	56
IBM 704 (70% discount)	71	60.0	24,000	7	17	1.60	9	23
GE 210	81	10.0*	144,000	40	100	8.39	49	123
UNIVAC III	94	4.0*	360,000	100	250	18.09	106	264
BENDIX G-20 (Original Tape Specs.)	100	4.0	360,000	100	-	17.02	100	-
BENDIX G-20 (Modified Tape Specs.)	100	10.0	144,000	-	100	6.82	-	100
RCA 501	103	10.8	133,333	37	93	6.13	36	90
IBM 7070	125	12.6	114,286	32	79	4.30	25	63
IBM 7074	152	12.6	114,286	32	79	3.56	21	52
HONEYWELL 800	170	3.3	436,363	121	303	12.15	71	178
CDC 1604	170	15.0*	96,000	27	67	2.67	16	39
IBM 704	173	60.0	24,000	7	17	.65	3	9
PHILCO 2000 (210)	190	3.8	378,947	105	263	9.45	56	138
IBM 709	200	25.0	57,600	16	40	1.36	8	20
RCA 601	204	2.0	720,000	200	500	16.68	98	244
PHILCO 2000 (211)	235	3.8	378,947	105	263	7.63	45	112
IBM 7080	240	12.6	114,286	32	79	2.25	13	33
IBM 7090	271	12.6	114,286	32	79	1.99	12	29

*Data estimated

TABLE D-6
SORTING PROBLEM INDEXES
(40,000 Records)

System	Price Index	Time Required (min.)	1000 x Sorts per Day	Capacity Index (a)	Capacity Index (b)	Sorts per Day per Dollar	Efficiency Index (a)	Efficiency Index (b)
IBM 709 (university discount)	71	198.6	7,251	22	40	.48	32	40
IBM 704 (70% discount)	71	400.0	3,600	11	20	.24	16	
GE 210	81	75.0*	19,200	60	107	1.12	73	132
UNIVAC III	94	40.0*	36,000	112	200	1.81	118	212
BENDIX G-20 (original tape specifications) (a)	100	44.6	32,287	100		1.53	100	
BENDIX G-20 (modified tape specifications) (b)	100	80.0	18,000		100	.85		100
RCA 501	103	96.0	15,104	47	84	.69	45	81
IBM 7070	125	64.4	22,360	69	124	.84	55	99
IBM 7074	152	64.4	22,360	69	124	.70	46	82
HONEYWELL 800	170	36.6	39,344	122	219	1.10	72	129
CDC 1604	170	120.0*	12,000	37	67	.33	22	39
IBM 704	173	400.0	3,600	11	20	.09	6	10
PHILCO 2000 (210)	190	39.5	36,456	113	203	.91	60	203
IBM 709	200	198.6	7,251	22	40	.17	11	
RCA 601	204	20.0	72,000	223	400	1.67	109	197
PHILCO 2000 (211)	235	39.5	36,456	113	203	.73	48	86
IBM 7080	240	64.4	22,360	69	124	.44	29	52
IBM 7090	270	77.9	18,485	57	103	.32	21	38

*Estimated

APPENDIX E (1)

RESULTS OF THE COMPUTER USER INTERVIEW PROGRAM

To augment the statistical work done to analyze and evaluate computer market trends, it was concluded that a limited number of user interviews should be made. Respondents were approached by our staff members who, representing an anonymous manufacturer, were seeking information on how users could be served better by manufacturers and opinions on certain phases of the computer industry. Individuals expressing these opinions were assured that they would not be quoted directly and that their views would not be held up as representative of the views of the organizations they served. On this basis, most interviewers, anxious to make their views known to manufacturers, expressed their opinions rather freely.

While time and budget did not permit scientific sampling and questionnaire techniques, knowledgeable and representative users were selected in various industries and geographical areas of the country. A concerted effort was made to select interviewees who were <u>not</u> currently IBM users, as well as those who are, to try to avoid a completely biased response, but because of IBM's market position, most interviewees had some type of IBM equipment in their computer systems. The interviews were conducted in some depth, guided by a questionnaire, and the responses generally paralleled the findings of the statistical analysis.

1. IBM COMPLETELY DOMINATED THE FIELD

The history and current situation at respondent locations indicated that most were and are IBM customers. While there was equipment of other manufacturers scattered around, 90% of the respondents had IBM products installed. A consensus of responses relating to equipment is briefly summarized as follows:

(1) Most installations had card preparation and input systems.

(2) Program assistance and availability were at least as important as the somewhat minor technical performance differences to most users, and usually more important than price when the installations were being considered.

(3) Nearly all installations were leased and few users were in favor of outright purchase.

(4) Most installations were being used up to, or almost up to, capacity.

(5) Even though respondents were selected heavily from the engineering and scientific area, most mentioned a preference and need for data processing capability also.

(6) Most users were attempting to develop their own skilled programming staffs, but wanted assistance available from the manufacturer.

(7) Most interviewees belonged to, supported, and favored organized user groups.

(8) 70% of the users ran and favored an open shop.

APPENDIX E (3)

2. MOST RESPONDENTS WERE PROSPECTS FOR ADDITIONAL EQUIPMENT SALES NOW OR IN THE NEAR FUTURE

In line with the fact that most present installations were being used nearly up to capacity, respondents generally indicated that they were in the market for additional equipment, were ready to "trade up" to bigger machines, or were at least considering it. There was a tendency, as the user acquired more experience, for the work to expand to fill available machine time. There was general agreement that some sort of feasibility study was the first step in the process of expanding installations and that equipment selection probably would be based again on program assistance availability, performance, and price - in that order. Nearly all respondents were certain that they would be spending more money for equipment three years hence than they are now.

3. IBM WAS PRE-EMINENT IN THE AREA OF SALES AND SERVICE COVERAGE

Though most respondents were experienced users and thus less prone to depend completely on manufacturer image, most agreed that, like it or not, IBM was pre-eminent in the field as far as sales and service were concerned, and, more important, certainly conveyed that image to the users. IBM sales and service coverage was far and away the most extensive. Nearly all had been contacted at least once by almost all manufacturers during the preceding six months, but IBM has and maintains the most complete sales coverage. Some respondents, although favoring other manufacturers' hardware to a marked degree,

indicated that they would probably string along with IBM because they felt safer with this choice, or because their management would reverse their decision if they proposed non-IBM equipment, based on the image that IBM has been able to project.

The respondents contacted during the course of the field work were, as a group, more experienced and sophisticated than the average prospective buyer of computer equipment, and consequently made more knowledgeable and pointed remarks during the course of the interviews. Not all of them thought that IBM was all things to all people in this field, of course, but enough of them did "give the devil his due," reluctantly or otherwise, to indicate how overpowering the IBM image and sales coverage efforts are in this field, and how important "software" is to the distribution of hardware. Users frequently made the observation that they usually had to go to a great deal of trouble to seek out and learn something from manufacturers other than IBM, and that these manufacturers could not be relied upon to contact them voluntarily and provide accurate information. In contrast to this, IBM representatives were covering them and providing information about their products on a regular and frequent basis.

4. IBM WAS THE TOP RANKED MANUFACTURER PRIMARILY BECAUSE OF THEIR MARKETING ABILITIES

In evaluating available equipment and suppliers, only 50% of the respondents ranked IBM equipment first, but 80% ranked IBM as tops in respect to program and applications support and caliber of sales and service.

Most respondents observed that, for their purposes, some of the more technical differences in hardware capabilities were secondary to the program and applications support and the availability of service. A summary of the opinions expressed about each manufacturer is as follows:

(1) Bendix - good hardware, little else known.

(2) Burroughs - good hardware, little else known.

(3) Control Data - good hardware, little else known, even hardware not widely known.

(4) GE - capable, good image, beginning to make their presence known.

(5) IBM - top rated image, sales, and service.

(6) Honeywell - good hardware, making marketing efforts felt.

(7) NCR - not well known or evaluated.

(8) Philco - good hardware, beginning to make slight marketing effort, high price.

(9) RCA - good hardware, making marketing efforts felt.

(10) Remington Rand - well known, acceptable hardware, weak in marketing and sales effort.

(11) Royal McBee - thought of more as office machinery supplier than computer manufacturer.

In addition to the above-described field work, the services of the Booz, Allen & Hamilton electronic data processing group were drawn upon freely to augment our efforts in the field of equipment evaluation, especially in the technical areas.

Exhibit E-I, following this page, gives a complete list of respondents contacted and interviewed in depth during the course of the field work. Following Exhibit E-I is Exhibit E-II, a sample of the questionnaire used to guide the interviews.

EXHIBIT E-.(1)
BENDIX CORPORATION

RESPONDENTS TO FIELD SURVEY INTERVIEWS

U. S. Navy
Bureau of Ships
Washington, D. C.
Chief, Computer Systems

Bureau of Standards
Washington, D. C.
Chief, Applied Mathematics

Chas. Pfizer & Co., Inc.
Brooklyn, New York
Chief, Computer Systems

United Aircraft
East Hartford, Connecticut
Director of Scientific Computers

Grumman Aircraft
Long Island, New York
Director of Research

Socony Mobil Oil Co.
New York, New York
Assistant Director, Computer Center

Union Carbide Corp.
New York, New York
Chief, Computer Systems

North American Aviation, Inc.
Downey, California
Superintendent, Digital Analysis

Space Technology Laboratories, Inc.
Los Angeles, California
Associate Director, Data Reduction Center

Richfield Oil Corp.
Los Angeles, California
Linear Programming Director

Marquette University
Milwaukee, Wisconsin
Director of Computer Center
School of Engineering

Motorola, Inc.
Chicago, Illinois
Systems Director

Monsanto Chemical Co.
St. Louis, Missouri
Assistant General Manager

McDonnell Aircraft Corp.
St. Louis, Missouri
Director, Engineering Computer Facility

Armour Research Foundation
Chicago, Illinois
Assistant Director, Electronics Research

Admiral Corp.
Chicago, Illinois
Director of Systems Department

A. O. Smith Corp.
Milwaukee, Wisconsin
Technical Director

The Standard Oil Co. (Ohio)
Cleveland, Ohio
Chief, Data Processing

Bell & Howell Co.
Chicago, Illinois
Director of Computers

Babcock & Wilcox
Alliance, Ohio
Vice President, Research

American Enka
Enka, North Carolina
Chief Engineer

Teletype Corp. (AT&T)
Chicago, Illinois
Director, Computer Center

EXHIBIT E-I (2)

Allis-Chalmers Mfg. Co.
Milwaukee, Wisconsin
Director, Computer Department

Phillips Petroleum Co.
Bartlesville, Oklahoma
Director, Computer Center

Humble Oil Co.
Houston, Texas
Supervisor, Computer System

Bendix Research
Detroit, Michigan
Supervisor, Computer Systems

Socony Mobil Oil Co.
Field Research Lab.
Dallas, Texas
Supervisor, Computer Systems

EXHIBIT E-II (1)

Company ______________________________

City ______________________________

Interviewee ______________________________ Name

______________________________ Position

Interviewer ______________________________

Date ______________________________

EXHIBIT E-II (2)

I. HISTORY AND CURRENT SITUATION

1. Please review the company's use of electronic data processing equipment.

(1) Date of First Installation

(2) What Applications

(3) What Equipment

- - - - -

(1) Date of Second Installation

(2) What Applications

(3) What Equipment

- - - - -

(1) Date of Third Installation

(2) What Applications

(3) What Equipment

EXHIBIT E-II (3)

2. What equipment does your company now operate?

Central Processor: MFR.________________________ MODEL__________
Tape Units: NUMBER________________________ TYPE__________
Input and Output Equipment:

____
____
____
____

How is program data prepared?

____
____

How is input data prepared?

____
____
____

Rank the factors that governed the selection of this equipment.

Price________________________ Performance__________
Manufacturer________________________
Program Availability________________________
Compatibility with Existing Equipment________________________
Other________________________

Do you lease or purchase this equipment?________________________

Approximate Monthly Rental $________________________
or Purchase Price $________________________

3. How many hours per MONTH - WEEK - DAY are you running on the central processor?

____

4. What is the approximate split of this time between engineering and scientific__________%
and data processing__________%?

EXHIBIT E-II (4)

5. Briefly describe your more typical engineering and scientific problems.

Rank Main Application(s)

6. Briefly describe your data processing applications.

Rank Main Application(s)

7. Briefly describe the operation of your computer installation.

Open or closed shop?

Extent of internal utility and systems programming?

What program support do you expect the manufacturers to provide?

What benefit do you derive from user organizations?

EXHIBIT E-II (5)

II. FUTURE PLANS

1. Do you see any future changes in the use and application of your computers?

2. What implications do these changing requirements have on your computer capabilities?

3. What plans do you have for future equipment additions, replacement or changes?

4. What procedure will you follow in the selection of this equipment?

EXHIBIT E-II (6)

5. What factors will govern this selection (in their order of importance)?

Price________________________
Performance________________________
Manufacturer________________________
Program Availability________________________
Compatibility with Existing Equipment________________________
Other________________________

6. How much do you think you will be spending for equipment three years hence as compared to now?

III. EVALUATION OF AVAILABLE EQUIPMENT AND SUPPLIERS

1. How would you rank available computers in their ability to fulfill your needs?

2. How do you rank the various manufacturers in respect to program and applications support?

EXHIBIT E-II (7)

3. How do you rank the manufacturers with respect to the caliber of their sales and service?

4. What manufacturers have called on you in the past six months? (How many times?)

5. What is your over-all opinion of each of the following manufacturers?

Bendix ______

Burroughs ______

Control Data ______

GE ______

IBM ______

Honeywell ______

NCR ______

Philco ______

RCA ______

Remington Rand ______

Royal McBee ______

EXHIBIT E-II (8)

IV. DISCUSSION OF FUTURE TRENDS IN THE USE OF COMPUTERS

1. Impact of Modular Design -

   Large vs. Multiple Small

   Satellite Concept

2. Application Centralization or Decentralization -

   Scientific vs. Business vs. Process Control

3. Will a used computer market develop?

4. What impact do you see service bureaus having on developments in the computer industry?

5. What hardware or software needs do you envision that are not now satisfied?

ATTACHMENT # 3

THE WEED OUT!

Still prognosticating a dim future for the staying power of computer manufacturers, a generous number of market analysts have gathered and garnished their statistics with perfectly reasonable logic.

Their basic contention: although the market for hardware will continue to prosper, it is clearly impossible for the present number of computer manufacturers (a) to survive the substantial investment required for advanced technology, particularly where there is no strong alternative market to absorb heavy annual losses (i.e., t.v. sets or electric razors); (b) to maintain satisfactory field support and software backup; (c) to mass produce medium and large scale systems, and finally (d) to compete with a large flock of comparable firms, all offering basically the same equipment for "a narrow, vertical market."

Their conclusion: "the weed out" will surely take place within a handful of years with three or four firms dominating the field and the remainder (if they insist on remaining) accepting a minute fraction of the market.

In support of their forecasts, market analysts have been confronted with one irksome problem, namely, *all visible evidence of late, has indicated they are dead wrong in both contention and conclusion.*

editor's readout

Despite the fact that a number of forecasts have pointed to small companies as the first to expire, it is precisely in this area where some of the real strengths of the industry have appeared. Not only have these "weenies" persisted in selling their machines, but they continue to announce new hardware of sizeable proportions.

Perhaps the best example is Control Data Corp. with its 160A, 1604, soon-to-be-announced 924 and Stretch-class 6600. Packard Bell Computer is another case in point where rumor of corporate lack of optimism in its computer division will find little support when PB announces its 350 late this Fall. Computer Control Corp.'s forthcoming DDP and El-tronics' ALWAC IV, a solid state entry to be ready next year, are further indications that the staying power of the small company is not to be underrated.

Having recently completed its 100th 7090 installation and with a flock of small to medium-sized contenders rolling off its production lines, there is little doubt that IBM will continue as the giant in the computer industry. But companies such as RemRand, well-known for their ability to turn an advantage into a loss, have shown promising signs of twisting the bit in the opposite direction. Surprises are also forthcoming from RCA with research in high speed circuitry through diode memory.

As for others: Burroughs is very much in the solid state field with the 5000, 270 and forthcoming announcement of the 260. Philco has stuck neatly to its 2000 series improving speeds with the 212. Advances in high speed tape units and mass storage devices are also under development by Philco.

Sales of the Honeywell 400 have been excellent and FACT although embarrassingly late, reportedly is now ready to fly on the 800. Some technological rabbits may also be pulled out of General Electric's new Sunnyvale hat.

In general, the most pessimistic news for computing market analysts is the obvious fact that within the last three years, no one has left the field. There are of course, some trends which have influenced the health of the industry; namely, a tempering of the early fever of the sales pitch which could easily have driven a company or two into trauma and ultimately out of the computing business. Also, there is a maturing realization of the need for long term investment coupled to a gradual shift in the purchase vs. rental balance providing smaller firms with a more encouraging, earlier dollar return. Finally, the field itself has expanded from what may have been a narrow, vertical base of a decade ago to a rapidly growing tree sprouting numerous horizontal branches such as process control, real time control, and many new areas of general purpose application.

It would seem therefore, that "the weed out" is hardly a frightening prospect except that as the prophecies do not bear fruit, the job security of the prophesiers may be inversely effected

Attachment # 4

Bendix gives up on computers

It is selling its Computer Div. to Control Data Corp. Sale price, according to a preliminary agreement, is under $10-million to be paid in cash and stock

Whenever a contender in the electronic computer business cashes in his chips—as Bendix Corp. announced it was doing this week by selling the assets and business of its Computer Div. to Control Data Corp.—the poker faces of the remaining contenders stiffen. They know that with another man dropping out, the game may well get harder rather than easier. The game of Electronic Data Processing—or EDP—is played with megabucks, and it's almost as fast as three-card Monte.

The loss. Most people in the industry believe that it cost Bendix as much as $30-million to try its luck. But Bendix Pres. Malcolm P. Ferguson says that a $40-million investment figure that has been circulating through the industry is extraordinarily high. At this time, he refuses to say how much Bendix did invest in computers. According to a preliminary agreement between Control Data Corp. and Bendix, the purchase price for Bendix's computer division is under $10-million, to be paid in stock and cash over a period of time.

If the loss is in that magnitude, it indicates that getting out of the game is more costly than ever. Royal McBee Corp. and Underwood Corp., both of which backed away from the table when the stakes started to skyrocket, figure they lost about $8-million and $12-million, respectively.

Stubborn optimism. Bendix's departure also has started speculation among the kibitzers that this may be the beginning of a shake-out in the industry that will result in a sudden rush of mergers or dropouts. But, even though few companies in the industry have seen black ink on their books yet, a major shake-out or merger trend is unlikely at this time. The remaining contenders in the business-scientific field—International Business Machines; Univac Div. of Sperry Rand; Control Data Corp.; General Electric Co., Philco Corp., a subsidiary of Ford Motor Co.; RCA; National Cash Register Co.; Minneapolis-Honeywell Regulator Co.; Burroughs Corp.; and Monroe Calculating Machine Co., a subsidiary of Litton Industries—all feel stubbornly certain that it's in the cards that they'll be among the big winners.

Not a few of these companies have suffered shortages in working capital because of the delayed return on leased equipment. But most console themselves with the thought that they would be in the black if equipment out on rental were considered as sold. In other words, if they had sold their computers instead of renting them, they would be ahead of the game. Even if such rationalizations are not the way the game is played according to the rule book, it helps morale.

Early starter. Although Bendix was one of the early computer manufacturers—it delivered its first G-15 computer to an oil company in 1955—it never "had big ambitions in business data processing," according to Ferguson. The G-15 computer is a relatively small, electron-tube computer used primarily for engineering and scientific calculations. About 270 of them have been sold since 1955.

In 1959, the company decided to build a transistorized computer slightly larger than the G-15. It grew into a much larger system—the G-20—a large-scale data processor that can be used for both business and engineering. However, because of its relatively limited marketing program, Bendix was unable to develop as complete a line of software—programming packages for users—as its competitors, and the G-20 sold slowly.

Beginning of the end. When Bendix failed to replace the G-15 with an equivalent transistorized computer, its market position plummeted.

Last year, Ferguson announced that Bendix was giving up all attempts to get into business data processing and would concentrate on engineering and scientific markets only.

Natural buyer. When Bendix made the decision to withdraw, it didn't take long to find a buyer. There are good reasons why CDC wanted it. The Minneapolis company, famous for being the only other profitable operation in the computer business besides IBM—is strictly a computer specialist. And the Bendix line dovetails nicely with its own.

Started by a group of engineers from UNIVAC in 1957, CDC's first product was a large-scale solid-state computer, the 1604. This was delivered in 1959, and 43 of them are now in operation. Initially, the company's objective was to make a fine computer and sell it to customers—universities and research laboratories—who knew how to program it and would need a minimum of expensive programming and training aids.

Generally, CDC has used a highly accurate marketing technique. It claims it sells two out of every three customers to which it presents a systems proposal (average cost—$20,000 a pitch).

Good fit. Bendix fits right into CDC's future plans. The older tube-model G-15 is slightly smaller than CDC's solid-state 160 computer. And since customers almost always move up when they replace a computer, CDC will have a fine basis for upgrading G-15 users to its own 160s. And the G-20—the big Bendix unit—fills a niche in Control Data's line of larger equipment, an extensive array that includes the largest and fastest computer systems now made in the U.S.

Bendix Sells Computer Division for $10 Million

The Los Angeles-based computer division of the Bendix Corp. is being sold to a Minnesota company for a price in stoc kand cash of "under $10 million."

Bendix announced the deal jointly wit hthe purchaser, Control Data Corp. of Bloomington, Minn.

Control Data will take over all assets of the division, including a plant at 5630 Arborvitae in Los Angeles. The plant employs 485 persons. Control Data did not neveal its plans for the local operation.

The joint announcement did state, however, that Control data will continue the line of Bendix G-15 and G-20 computers. The G-15 is a small computer primarily used for scientific and engineering jobs. The G-20 is large scale, solid state digital computer used in both engineering and data processing applications.

The deal is subject to approval of boards of directors of both companies by March 15.

No reason was given officially for the sale. But it has been well known that Bendix has been disappointed with its earnings in the highly competitive computer business.

North American Aviation Unit Drops Computer Line

By a WALL STREET JOURNAL *Staff Reporter*

LOS ANGELES—Autonetics division of North American Aviation, Inc., will discontinue its line of commercial computers, John R. Moore, division president announced.

Mr. Moore said the computer line, called RECOMP, "was designed for a small, specific market of industrial appliciations" and it was "a management decision not to continue in this field." Autonetics, however, plans to continue its work on computers for military and space use "which has constituted the great bulk of our computer activity," the official said.

The division, which entered the field in 1959, declined to specify annual volume of the RECOMP line, but it is understood some 100 have been sold or leased; prices of the two-model line range from $65,000 to $95,000. The division didn't detail reasons for dropping the computer but it was said that Autonetics faced either expansion and updating of its line—and consequently further investments — or abandonment of it entirely.

RECOMP computers in inventory will be sold and service personnel will be absorbed into Autonetics' computer and data systems division to provide continuing service for users of machines already in operation. Many of some 300 RECOMP workers will be transferred to other jobs within Autonetics, the division said.

Exhibit 3.—*William Rodgers Article Re "IBM on Trial"*

[From Harper's, May 1974]

IBM on Trial: Monopoly Tends To Corrupt

(By William Rodgers)

In the constellation of multinational corporations, one illuminates the economic firmament more than any other. It is International Business Machines, whose 575,000 stockholders early this year owned 146,061,750 shares with a sale value even in a depressed market of $36.5 billion. Their company, the undisputed colossus of the computer industry, has made many of them millionaires. It has enriched to the level of affluence anyone able to acquire and retain two or three hundred shares since the computer market developed in the 1950s. Its products and services are sold in four out of every five nations on earth. Last year, on revenues of $11 billion, it earned $1.58 billion, up 23 percent from 1972. Its reserves and marketable securities are so extensive that income from interest alone would put IBM on any select roster of American corporations. Measured by its revenues, IBM ranks sixth in the United States. No one knows for sure—only IBM itself has the confirming or refuting data—but the company probably commands 75 to 80 percent of the computer business in the United States and more than half of the world market. IBM concedes that it gets perhaps 35 percent of the industry revenues, but the courts and its competitors scorn that unsupported estimate as nonsense.

Whatever the extent of its monopoly, IBM has reaped well over 90 percent of profits generated in the computer industry in this country. All the other companies, including some of substantial size—Honeywell, Burroughs, Control Data, Univac, National Cash Register—scrounge with varying degrees of success for what's left. IBM could probably obliterate any or all of them if it chose, or if it dared provoke further antitrust litigation of the sort in which it already is expensively involved. Computer divisions of Philco, RCA, and General Electric have been demolished over the years in unequal combat with IBM. But IBM now *needs* competition and tolerates it for appearance's sake, suffering meager growth among its harmless foes as evidence of pluralism in the computer world.

THE KINGDOM OF IBM

In its sixty-year history, IBM has accumulated, besides its dominance over a highly profitable and expanding industry, a remarkable reputation among multinational corporations. It is a reputation that developed from the personal style and perseverance of Thomas J. Watson, Sr., who ran the company as a family fief from 1914 until shortly before his death in 1956. Watson was a benevolent tyrant who, as an associate of the legendary John Henry Patterson of the National Cash Register empire in Dayton, Ohio, had been fined and sentenced to a year in prison on a conviction of antitrust violation before Patterson fired him in 1913. When he was exempted from serving the sentence after the court ordered a second trial, which never occurred, Watson was hired to run a small, newly formed company making tabulating devices, grocery-store scales, cheese slicers, and other "business machines." The company was christened IBM in 1924.

Watson had a fierce temper, a pietistic affinity for the eternal verities, an evangelist's fervor for business, and an unswerving compulsion to work. He developed his own version of reinforcement psychology before the world had heard of B. F. Skinner. In the kingdom of IBM, men were alike in style and manners—well groomed, well barbered, courteous and attentive, dressed in dark suits, polished shoes, and mandatory white shirts that identified them as members of the Watson-IBM family. They lived and worked and generally prospered according to a paternalistic, autocratic code that guided their conduct, aspirations, and progress upward in—or out of—the company. On this Victorian principle of "doing right," and on the principles of meeting ever larger sales quotas, of total subordination to one's job, of clean living and clean thinking, IBM was built. Its reputation for probity, strict attention to business, and concern for its customers extended around the world.

Concurrent with developing its benevolent image across the continents and the decades, IBM established one of the finest sales and customer-service organizations in all industry. Although a little late moving into the computer business after World War II, IBM took virtual possession of the business by recruit-

ing scientists and technicians and by retraining its army of salesmen and engineers.

Locking in customers and freezing out competition, without notably impinging on its reputation for wholesomeness and fair play, characterized IBM marketing operations as far back as the 1930s. The Justice Department in the Roosevelt administration brought an antitrust action against IBM and Remington Rand, which in the precomputer era shared the lucrative tabulating-machine-and-card business.

In 1935 a federal court found that IBM had under lease 85.7 percent of all tabulating machines, 86.1 percent of all sorting machines, and 82 percent of all the punch-card installations then used by American business and the government itself. Remington Rand had all the rest of the business under an agreement with IBM. This "mutual sufferance" arrangement was dissolved in 1936, in a ruling upheld by the Supreme Court.

Twenty years later, the government, in an antitrust case that terminated with a consent decree, tried to compel IBM to make way for competitors, and to curtail the company's power to sustain its monopoly. By then the computer had revolutionized the data processing business, and the decree scarcely gave the company pause.

The Government struck again in 1969 with the largest antitrust case ever launched against any company, a case scheduled to go to trial late in 1974. In the five-year period between the initiation of the litigation and the beginning of the trial, IBM will have grown by more than $1 billion in sales each year.

This latest antitrust action was, in part, the government's acknowledgement of complaints and protests from competitors charging that IBM had not allowed entry and growth beyond a token level, to other companies in the industry. The complaints further alleged that IBM had devised a sophisticated system of predatory practices with which to destroy competitors attempting to gain a foothold in the business. The IBM empire, said its surviving competitors, had become too immune to the restraints of power, too dangerous and ruthless to be tolerated in the social and industrial community.

Today the company's competitors and the government are up in arms against it both in the marketplace and in the courts. Besides the federal government's suit, which wasn't pressed for four years because of a lack of prosecutorial interest on the part of the Nixon Justice Department, there are presently pending against IBM twelve punitive and treble-damage suits initiated by companies and individuals seeking $4.3 billion collectively. In one suit last fall, a U.S. District Court in Tulsa, Oklahoma, awarded $259.5 million to the Telex Corporation. Earlier in the year, IBM settled, prior to trial for $110 million, a damage suit filed in December 1968 by Control Data Corporation. The disclosures made in both cases tended to cast some doubt on IBM's image of self-righteous probity.

THE END OF THE MONOPOLY

Questions of immeasurable significance, questions raised in Congress a century ago when debate raged over the issue of regulating corporate power, have been brought into focus with such clarity that their resolution can no longer be indefinitely delayed. The escape of multinational corporations from the bonds of sovereign authority, the anxiety and runaway prices provoked by the world energy crisis, the incestuous affinity between company directories and ministries of the state all arouse political agitation for more supervision over worldwide industrial empires. IBM is by no means alone in provoking cries for restraint. It is, however, a corporation distinguished by the extent of its monopoly over what has become a basic industry. It is uniquely alone in its need to defend itself against the Justice Department, which wants to break it up into a number of separate entities, and against private and corporate damage claims for more than four, possibly seven, billion dollars.

How could the monarch among multinationals, its logotype known across the world, with its all but hallowed reputation, stumble into obvious pitfalls and expose the dingy underside of its carefully polished image?

And what are the economic, moral, and social implications of a national resource company like IBM being brought before several courts, perhaps for years? How can a nation punish or restrain an industrial resource of such magnitude without inflicting punishment or crippling restrictions on the economic system with which it is inextricably entwined?

It is IBM's position that none of these supposed evils can or should befall it. But the Justice Department argues that law and order must restore competition and a fre market , and it hopes to apply an old measuring rule, which holds that competition is stifled when three or four companies carry off 50 percent or more of any category of business. IBM is prepared to plead that it is being discriminated against, that the old measuring rule is invalid, dishonored by numerous exceptions. The argument has compelling substance. Companies like Kodak, Xerox, and Western Electric, among others, mock almost any definition of monopoly. Four automobile manufacturers don't possess just 50 percent of the business; they have all of it, excluding imports.

What is worrying IBM, aside from the possibility of fifteen damage suits relieving the company of perhaps billions of dollars, is the prospect of a new and galling relationship with the federal government. For the Justice Department's suit covers many of the issues of the Telex case, in which IBM was found guilty. The verdict is under appeal, but the evidence supporting it, evidence from IBM's own internal records, has entered the public domain and is available to all litigants, including the government. The evidence appears to be impressive—so much so that last fall Thomas D. Barr, partner in the Manhattan law firm Cravath, Swaine & Moore, which is defending IBM in the government suit, redefined the case. In a dialogue with Chief Judge David N. Edelstein of the U.S. District Court of Southern New York, Mr. Barr saw the issue to be decided as one beyond the evidence. Barr said:

"I think we have, in a sense, your Honor, almost a classic confrontation between two different concepts of what the antitrust laws are all about and what our system is all about."

Whether or not his defense strategy is successful, Mr. Barr was probably right about the implications of the case determining for years the relationship of the antitrust laws to "our system." By going to trial in the Telex case, IBM lost the secrecy of its internal documents, and what emerged from these documents was a blueprint inadvertently proving, at least to the court, that IBM was a predatory monopoly. Having sacrificed in all likelihood its capability of proving it is neither a predator nor a monopoly, it is obliged in the government suit to satisfy the courts that its monopoly status is a good thing, an extension of the public interest.

In other suits, where litigants have assembled to seek redress, IBM must wear them down by delay and attrition, seeking individual settlements before trial in amounts less than claimed by its adversaries. With more money and staying power than all its opposing litigants put together, the company might prevail.

A BLOW TO CONTROL DATA

The pending confrontation between IBM as defendant and the government and companies as prosecutor and plaintiffs had its genesis in the '60s and in the character and temperament of corporation management. In 1965 Control Data Corporation was the only computer company in the country besides IBM to show a profit. William C. Norris, president of Control Data, led a group of gifted scentists in demonstrating a remarkable ability to raise capital on Wall Street. It was a time of easy money, to be sure, but Norris raised a lot of it. New advances in miniaturization of components, circuits, and systems persuaded investors that golden times were ahead even for upstart companies daring to compete with IBM. Because growth possibilities seemed so vast, they were persuaded, too, that IBM, under restraints imposed in the 1956 antitrust consent decree, would tolerate competitors. On that point they were woefully wrong.

Norris entered the market with his famed Model 6600, the largest computer in the world, a multimillion-dollar system designed for aircraft production, government, and heavy industry. The promise of its arrival sent Control Data stock soaring from 32 to 161 in a matter of months. Coincidentally, IBM announced that it intended to market an improved version of the Control Data machine. The news discouraged prospective CDC customers. IBM never manufactured its version of the Model 6600, but its presumed imminence caused CDC stock to plummet. Outraged, Norris complained to the Justice Department. He denounced the management hierarchy of IBM, then ruled by Thomas J. Watson, Jr.; his younger brother, Arthur, who became Ambassador to France during Nixon's first term; and T. Vincent Learson, who succeeded to, and is now retired from, the office of chief executive. The government procrastinated, and in December of 1968 Norris filed a treble-damage suit against IBM. A year later, on the last day of the Johnson administration, the Justice Department filed its own action charging the company with a wide range of monopolistic practices.

Four years later, early in 1973, IBM settled out of court by giving Norris one of its subsidiary companies and cash amounting to $110 million. In a prelude to the settlement, IBM surrendered to CDC lawyers millions of pages of previously classified in-house data. Norris spent $3 million for a computerized index of these files, which Telex and other litigants studied and researched. It was said to be a compendium of evidence highly useful to the forthcoming government antitrust trial. But immediately upon reaching an accommodation with Norris, IBM got back the voluminous index of microfilm, papers, and tapes and, as *Fortune* magazine reported, destroyed them by erasure, acid bath, and mulching vats.

Irked by IBM's destruction of the CDC file and index, Judge Edelstein imposed a fine of $150,000 a day on IBM for failure to purge itself of contempt by yielding up some twelve hundred documents that he had asked for and IBM had failed to produce. In what sounded like a reprise of a theme by Mr. Nixon, then in retreat from a summer of Watergate hearings and disclosures of "lost" and withheld documents, IBM pleaded its version of executive privilege and confidentiality between lawyer and client.

Judge Edelstein retorted that since CDC counsel had looked at the material for months he wanted to see it, too, on the ground that it was doubtless germane to the government's suit against IBM. Before one day of the unprecedented fine had passed, the company persuaded another federal court in Connecticut to grant a stay, and the $150,00-a-day contempt sentence went to appeal. Even while cadres' of lawyers sparred with the Justice Department—coaching company managers in pretrial depositions and negotiating a settlement with Norris—special task forces at IBM's world headquarters in Armonk, New York, analyzed certain information that distressed the Watson brothers, Vince Learson, and other high-ranking executives. In antiseptic color-coded rooms, to which sales, manufacturing, and financial data were channeled from points of origin across the country, management detected signs of growth developing among small companies specializing in products and systems "plug compatible" with IBM mainframe units—or, as they are called, central processing computers.

Plug compatible, or peripheral, equipment is a large part of the computer industry. In fact, it is all of the equipment served by a central processing unit, which may be seen as a powerhouse supplying all sorts of attachments that make up computer submarkets—disk drives, magnetic-tape drives, impact printers, memory systems, communications controllers, direct-access data storage products, and so on.

In 1970 IBM took in more than $1.1 billion in revenues from peripheral products that were plug compatible with its mainframe units. All other manufacturers of plug compatible equipment combined took in a little more than $100 million on products designed for IBM computers. Thus the competition's share amounted to comparatively little. But it was growing. Although IBM's volume was increasing by more than $1 billion a year, other companies were making their way into fringe markets which provided very substantial revenues indeed. It was also clear that other companies were making products superior to those made by IBM.

A task-force analysis, produced in secrecy at Armonk, disclosed in documents that reached the court in the Telex trial that IBM did not shrink from turning up unpleasant intelligence about itself. The company assessed the quality of its own products and compared it to the competition's. Of twenty-six pieces of equipment evaluated, sixteen produced by IBM were found to be "deficient," four were superior, and six equal to those of competitors. Thus it was that the company confessed to itself, and by extension to the court, that it took in hundreds of millions of dollars in sales on products that were inferior to those manufactured by its hard-pressed competitors.

The better equipment cost customers a good deal less than IBM sold theirs for—and still made Memorex, Telex, California Computer, Transamerica, Marshall Industries, and a couple of others some money. This was IBM's own fault, since the company had been allowing itself as much as 50 percent profit on these items. Even after improving the quality, the competitors sold the equipment at a profit.

Yet to IBM these companies were parasites duplicating highly profitable attachments that wouldn't have had any market at all without its computers. By IBM's own reckoning and projections, these companies could expect continued success and growth by marketing superior products at less cost. With uninterrupted success, they could be expected to capture a 13 percent share of the market in these lines by the late 1970s. (It was, even in projection, a comparative pittance to a company with $11 billion in revenues in 1973, up from $7.5 billion in 1970 and $8.3 billion in 1971.)

Cooley's Task Force, so called because it was directed by IBM executive Henry E. Cooley, was advised that the examination of the competitive market in peripherals was of the most vital importance. It was designated as the "key corporate strategic issue." The Cooley team, supplemented by a Blue Ribbon Task Force, was spurred along by Tom Watson himself in its work to eliminate the upstarts. In 1971, as chief executive, Watson wanted it understood that "irrespective of financial considerations of one or two years," the future had to be made ready for unbroken growth. IBM had "to make the hard decisions today so that the same problems don't have to be faced again."

PRICE WAR

According to Federal Judge A. Sherman Christensen in his decision in the Telex case, it cost IBM $75 million to carry out its price-cutting campaign. This was the amount "lost" in long-term leasing plans and predatory price cuts established in 1971 and 1972—price cuts which IBM, with considerable accuracy, predicted would convert competitors into "dying" companies.

The specifics of the plan devised by IBM, the techniques by which customers were brought back into its fold and kept there, the design changes of products—mid-life enhancement, it was called—by which competitors' inventories were made obsolete, the calculated losses IBM took on competitive equipment and recouped in part by price increases on noncompetitive lines are too complex for description in a brief article. It is clear that they served their purpose.

The business that had ebbed away from IBM to small companies drifted back with the tide. With two to three billion dollars in cash reserves on hand, IBM adapted the old gasoline price war technique, in which the chain with the most money could sell at a low price until competing stations were wiped out, then restore or rearrange prices to a nicely profitable level and go on as a growth company.

By the end of 1971, pretty much as projected, the Commercial Analysis Section, a kind of special intelligence and think tank unit of IBM's, cheerfully informed the management that independent companies were under control. Competing sales in two major lines of tape and disk equipment, for example, which had sustained Telex, Memorex, and a couple of others, had fallen off by 48 to 62 percent.

In and out of court, IBM has said it did nothing to any company that the same company wouldn't have done if it had had the resources, which is doubtless true. But unchecked by the power of government, which offered them only litigative, not immediate, redress, the companies could do nothing against the price war strategy of IBM. The court rejected out of hand IBM's testimony that the strategy was an experiment in marketing. It was "unadulterated predatory action . . . willful conduct with predatory intent . . . expressly formulated, analyzed, planned and aimed by IBM specifically at its plug compatible competition."

Memorex, which showed a net profit of $3.2 million in 1970, lost $13.4 million in 1971. Its subsequent losses were catastrophic. Its primary hope for a future, if any, rests on a $3.1 billion antitrust suit filed against IBM last December.

The other suits moving to trial or settlement seek divestiture, injunctions, and treble damages.[1] All of these raise the same questions. Why would IBM management, with the federal government belatedly aroused to the point of antitrust action against the company in 1969, resort to a costly strategy of overkill in order to wreak havoc upon companies so economically far beneath them? Beyond contending that all the litigation in process is without merit, or at best is a conceptual difference of law, high company officials make neither excuse nor explanation. But former IBM managers, some of them migrants from lofty levels of management hierarchy, are convinced that the overkill response was inevitable in the light of the mentality and character of IBM executives. It is simply not rational, they say, to expect the company to exercise restraints of its own volition. What failed was the power of government and law, the only countervailing force capable of imposing restraints on a corporation of enormous wealth and power. Justice too long deferred invites the acceptance of risk to circumvent law. The

[1] An action different from all the others was filed last September by eighty-year-old Vernon M. Bugg, Sr., an engineer and inventor who was Watson's assistant forty years ago. Mr. Bugg, who seeks $120 million in damages, charged that IBM confiscated prototypes of teletype machines he had invented and conspired with American Telephone and Telegraph Corporation to keep them off the market, thus preserving for AT & T its monopoly over the teletype business through all the intervening years.

experienced, sophisticated management of IBM was aware of the risks; it was explicitly advised of them by executives within the inner circle. The stakes—control of the market—were too tempting.

Otis Page, who quit IBM after eighteen years and went to Memorex in 1971, was a member of the task force at Armonk that helped plan the debacle. Before he left, he also helped prepare IBM's defense against the government antitrust suit.

He is no apologist for the management of Memorex, which he also has left: "These companies should know their business better. Memorex attracted capital on the assumption that IBM wouldn't do anything. Yet IBM does have awesome power. It is like the federal government, but on any order of magnitude its conduct hasn't been as bad, nothing to compare with Watergate. There is no question that IBM was wrong and did some bad things. Learson, Watson, the rest of them couldn't just sit there on all that strength."

Gary Friedman, a founder of ITEL, with years of management experience at IBM, is reputed to possess acute perceptions about the company's style. Friedman remembered "some guys going down to Wall Street to meet with securities analysts" during the price war. When they grasped the implications of it, one of the analysts asked:

"What's going to happen to Memorex?"

"Probably kill them," was the response.

One of the architects of the price-cutting structure was Berton Hochfeld, now a computer-industry analyst with Eberstadt & Company, a Wall Street firm. Even when he designed the price cuts, he counseled against them.

"I was worried about the law," he said. "The company's own counsel advised them about antitrust implications, too. I asked them what contingency fee I should budget for treble-damage suits. They didn't want to hear about it. Legal counsel was ignored."

Hochfeld is as bright and unsentimental about the contradictions of big-business policy as anyone in the computer industry. Having accomplished for IBM the job he was required to do, he is nevertheless conscious of the need for restraining monopolies.

"The principles of antitrust, as conceived in law, are more important than efficiency and the growth of corporations," he said. "The country cannot survive if we cannot have honest competition. This industry needs to be restructured, with divorcement according to product function; with divestment of peripherals, central processing, programming, plug compatibles, financing from each other. The users of computers and related equipment have the right to move from one vendor to another."

It is the courts, Hochfeld feels, that offer the best hope of fundamental reform. "Let the courts become a mechanism of social activism as a way of preventing the conscious parallelism that has perverted competition among large oil companies." Relying on consent decrees, limiting IBM's share of the market to some fixed measure—50 percent, for example; even breaking the company up, as the oil trust was broken up at the turn of the century, will not make competition flourish. History, says Hochfeld, will repeat itself unless the judiciary sustains diversity and pluralism in American industry.

A goading force for pluralism and competition and a new voice in the dialogue within the computer world is the Computer Industry Association, organized in 1972. Its members that year did a gross business of $800 million, a mom-and-pop-store volume by comparison with IBM but an amergent factor nonetheless. The CIA president is Dan L. McGurk, a former Rhodes scholar and former president of Xerox Data Systems, and, with Jack Biddle, its executive director, an articulate spokesman for both independent companies and computer users.

McGurk sees IBM as hard to reform. "Even when its price fell more than $38 a share after the Telex decision," he said, "IBM stock had a market value greater than any two companies' in the world. Competitors can handle only small or isolated markets. Sooner or later they run into IBM or it runs into them. Its share of the market is not decreasing. By a stroke of the pen almost any company can be put out of business.

"We are not anti-IBM. It is a very great company and a national resource. But it is the goal of every great company to become a monopoly. Even if you become a monopoly legally and morally, a paragon of ethical virtue, when you become an economic and monopolistic power, that power should be broken. There are laws against it. This industry needs relief from monopoly now. Without it, the monopoly can thrive but the industry cannot."

There is, indeed, a conceptual difference in law to be resolved. In one view monopoly exercises its power to prevail. In another, government and law exercise sufficient power so that competitors can prevail, too.

Harper's Letters

IBM ON TRIAL

William Rodgers' "IBM on Trial" [May] is blatantly misleading and in many instances demonstrably false. In addition, it draws conclusions about IBM and the data-processing industry that are contradicted by the findings of the two federal courts that have examined IBM's position in the industry.

Certainly, IBM and its legal affairs are proper subjects for public commentary. And I believe IBM is mature enough to accept critical points of view. However, I must object when a writer chooses to support his personal opinions with strident denunciations that contradict, misrepresent, or willfully ignore facts that are a matter of public record. For example, IBM has had two trials. IBM won one and lost one and successfully prevailed in four efforts by competitors to enjoin certain IBM practices. All those were brought under the antitrust laws. But Mr. Rodgers mentions only the one IBM lost.

The article's errors and omissions are pervasive; the following specific examples should give your readers some idea of how they were misled:

Statement: IBM is a "monopoly" in the computer industry, an "undisputed colossus." In a similar veiw, Mr. Rodgers quotes unnamed, "surviving competitors" as saying that the "IBM empire" is "too immune to the restraints of power, too dangerous and ruthless to be tolerated in the social and industrial community."

Fact: The two federal judges who have passed on the question have concluded after trial that IBM does not monopolize the computer industry.

Judge A. Sherman Christensen in the *Telex* case decided—in a ruling IBM now is appealing—that IBM had monopolized a narrow market defined as "peripheral devices plug compatible with the CPU's (computers) of IBM." However, Judge Christensen also concluded the following about IBM competitors and IBM's position generally in the computer industry: ". . . competitors include many large diversified companies with important skills and substantial financial resources, and many competitors are strong, independent and growing. . . . Between 1952 and 1970 the number of competitors in the EDP industry multiplied more than 136 times from 13 to 1773. . . . Broadly defined the EDP industry appears competitive and dynamic."

Judge Walter E. Craig, in dismissing the *Greyhound Computer Corporation* suit in July of 1972 after eight weeks of trial, found that IBM was not a monopoly and that "the defendant's place in the industry has been achieved as a result of superior skill, foresight and industry. . . . There is no evidence of any attempt to monopolize on the record."

Statement: IBM "probably commands 75 to 80 percent of the computer business in the United States. . . . IBM concedes that it gets perhaps 35 percent of the industry revenues, but the courts and its competitors scorn that unsupported estimate as nonsense."

Fact: The 35 percent figure is not IBM's, and it is not an "unsupported estimate"; it was a result of a court-administered industry census. In the *Telex* decision, the only one which dealt with percentage figures, Judge Christensen did not "scorn" the 35 percent as "nonsense." He specifically found that IBM's share of industry revenue was "35.1 percent in 1970."

Statement: Computer divisions of Philco, RCA, and General Electric were "demolished" in "unequal combat" with IBM.

Fact: The computer divisions were not "demolished" but, as Judge Christensen found, were acquired by Sperry Rand-Univac and Honeywell, whose competitive positions were "enhanced" by these acquisitions. And the Philco-Ford computer divisions recently reported electronic data-processing revenue in 1972 of $79 million in a computer-industry census.

Statement: In 1913 Thomas J. Watson, Sr., was "exempted" from serving an antitrust sentence "after the court ordered a second trial."

Fact: In 1913 Mr. Watson was indicted and convicted along with many other officials of National Cash Register Company, but Mr. Watson's conviction was reversed by the court of appeals: The government then proposed a settlement; Mr. Watson rejected the offer, and the government dropped the case against him. He was not "exempted" from serving a sentence; he won the case.

Statement: "Coincidentally, IBM announced that it intended to market an improved version" of Control Data Corporation's Model 6600, but "never manufactured" it.

Fact: IBM never announced "it intended to market an improved version" of the CDC 6600. Two years after the announcement of the CDC 6600, IBM did announce a model of the System/360 that was more powerful than the CDC 6600, and IBM manufactured and delivered a number of them.

Statement: IBM settled with CDC "out of court by giving Norris one of its subsidiary companies and cash amounting to $110 million."

Fact: IBM did not "give" CDC a subsidiary or $110 million in cash. The actual terms of the mutual settlement (IBM had countersued against CDC for antitrust violations) were: CDC *purchased* an IBM subsidiary for $16 million. IBM agreed to provide $2.6 million per year for ten years to assure the employees of that subsidiary (its former employees) their full, existing fringe benefits. IBM agreed to purchase from CDC $4.8 million per year of EDP services and $6 million of research and development work per year for five years. In addition, $15 million of CDC legal fees and expenses were paid by IBM.

Statement: The Justice Department "hopes to apply an old measuring rule, which holds that competition is stifled when three or four companies carry off 50 percent or more of any category of business. IBM is prepared to plead that it is being discriminated against, that the old measuring rule is invalid, dishonored by numerous exceptions."

Fact: Nonsense. There is no such rule and never has been.

Statement: Mr. Rodgers characterizes Berton Hochfeld, whom he quotes at length, as one of the "architects" of IBM's so-called "price-cutting structure" who "designed the price cuts," thereby accomplishing "for IBM the job he was required to do."

Fact: Mr. Hochfeld worked for IBM for just over two years after he finished his schooling. He was one of the hundreds of "financial analysts" at IBM and never held any kind of managerial position. Mr. Hochfeld conceded under oath that he was never responsible for setting any prices on any IBM products. Furthermore, Mr. Rodgers does not reveal that Mr. Hochfeld, after leaving IBM, worked as a paid consultant and witness for Telex.

Mr. Rodgers has taken up the cudgels of a few of IBM's competitors and ignored the unprecedented product and price improvements in computers passed on to consumers by the intense competition in the industry. That he is free to do, but we believe your readers and IBM should not be abused and misled by Mr. Rodgers' demonstrable distortions.

FRANK T. CARY,
Chairman of the Board, IBM.

WILLIAM RODGERS REPLIES: On the basis of Mr. Cary's critique of my article, one could develop an Orwellian thesis that corporate innocence flourishes in proportion to the magnitude of litigation against it.

Unlike Mr. Cary, *Harper's* readers will doubtless see my article as an examination of his corporation rather than as an attack against it. If he and his colleagues will look again, they will find that it was the failure of American law and government that I primarily criticized. It is the failure of government to at least restrain predatory power that has put the government in complicity with corporate power.

I am very sorry I imputed to IBM people I interviewed loftier managerial status than they deserved. I would have identified Berton Hochfeld as a consultant to Telex had I known he was one, so that readers could assess the validity of self-serving comments. My oversight of this fact is criticized by Mr. Cary, and appropriately so.

Whether or not the late Thomas J. Watson, Sr., "won" his antitrust case after conviction in 1913 is highly questionable. This case is recounted fully in my book *Think*, soon to be reissued in an updated paperback edition by New American Library. Certainly it is fair to say that he won exemption from serving a sentence when, three years after he had been fired from National Cash Register Company, the case simply withered away through a *nolle prosequi*, meaning the prosecution simply dropped it. I don't want to deprive Mr. Watson of any victory—if that's what it was.

Mr. Cary says computer divisions of Philco, RCA, and GE were not "demolished" in "unequal combat" with IBM but only "acquired" by other corporations. This is slicing language close to the bone. Demolition by acquisition is not uncommon. And if any company's position was "enhanced" in the process, it was IBM's.

The reference to a "measuring rule" cropped up in old antitrust and monopoly studies. As I explicitly stated, it never amounted to doctrine. Perhaps I need not have brought it up.

It is quite true that I did not dwell on the laudatory things said in the courts and other forums about IBM over the years. I did not purposely omit them as a literary technique to make IBM look wicked. My essay was an account of IBM trials, not of its virtues.

As for the question of whether IBM gets—or commands or controls—75 percent of the computer-industry market or, as it claims, 35 percent, that is surely an issue to be determined in the government antitrust trial headed for resolution. There are many different markets in the industry to which IBM's share of these markets gives it monopoly power and how that power is exercised.

For there is indeed an IBM empire. The company is, in fact, the undisputed (except by IBM) colossus of the industry. And it has the power, however achieved, to destroy most competitors at will. What the courts and the government will do about this, if anything, remains to be seen.

Exhibit 4.—*Proposed Final Judgment: U.S. versus IBM*

PROPOSED FINAL JUDGMENT FOR UNITED STATES OF AMERICA

PLAINTIFF

v.

INTERNATIONAL BUSINESS MACHINES CORPORATION,

DEFENDANT

in

United States District Court for the Southern District of New York

CIVIL ACTION NO. 69, CIV 200

U.S. v. IBM—PROPOSED FINAL JUDGMENT—SUMMARY INDEX

Article I. Court jurisdiction over IBM and officers and directors and Service Bureau Corporation, World Trade Corporation and Science Research Associates.

Article II. Definitions.

Article III. Divesture of service bureau business (Service Bureau Corporation, Science Research Associates and the network services operations, unbundled systems engineering operations, educational services operations and Federal Systems Division of IBM together with comparable service bureau operations of World Trade Corporation).

Article IV. Newly formed service bureau company not to manufacture or sell EDP Systems, ERP Equipment or Communication Equipment until such time as the IBM portion of its installed base is less than 35% and in no event sooner than 10 years.

Article V. Divestiture of components business (Components Division and other semiconductor and related elementary component research, development and manufacturing operations of IBM and comparable operations of World Trade Corporation).

Article VI. Newly formed components company not to produce "proprietary" products for IBM or successor EDP Systems companies, supply such companies with more than 50% of their respective requirements, or favor such companies in price or conditions of sale.

Article VII. Divestiture of office products business (Office Products Division and Information Records Division of IBM and comparable word processing, office products and information records research, development, manufacturing and marketing operations of World Trade Corporation).

Article VIII. Newly formed office products company not to manufacture or sell Communication Equipment for 10 years.

Article IX. Divestiture of small EDP Systems (under $5.000 monthly rent) business (General Systems Division and part of Advanced Systems Division re-

lated thereto and other small system, terminal and tabulating machine equipment, research, development, manufacturing, marketing and maintenance operations from IBM and comparable operations of World Trade Corporation).

Article X. Small EDP Systems company not to manufacture or sell large EDP systems (over $5,000 monthly rent) until such time as its share of the small EDP systems submarket reaches 35% or less and in no event sooner than 10 years.

Article XI. Small EDP Systems company not to manufacture or sell communications equipment (except terminals) until such time as its share of the small EDP systems submarket reaches 35% or less and in no event sooner than 10 years.

Article XII. Small EDP Systems company not to engage in the business of the components company, the office products company or the service bureau company until such time as its share of small EDP Systems submarket reaches 35% or less and in no event sooner than 10 years.

Article XIII. Small EDP Systems company to reduce its share of the small EDP Systems submarket to 50% or less within five years and 35% or less within ten years.

Article XIV. IBM retention of large EDP Systems (over $5,000 monthly rent) business under Court supervision for reduction in share of large EDP System submarket to 50% or less within five years and 35% or less within 10 years.

Article XV. IBM not to engage in small EDP Systems business until such time as its share of large EDP Systems submarket is 35% or less and in no event sooner than 10 years.

Article XVI. IBM not to manufacture or sell communications equipment until such time as its share of the large EDP Systems submarket reaches 35% or less and in no event sooner than 10 years.

Article XVII. IBM not to engage in the business of the components company, the office products company or the service bureau company until such time as its share of large EDP Systems submarket reaches 35% or less and in no event sooner than 10 years.

Article XVIII. Newly formed service bureau company, components company and office products company are restrained from acquiring more than 35% of their respective needs from new small EDP Systems Company or IBM.

Article XIX. IBM and small EDP Systems company directed to standardize high-speed communications interfaces.

Article XX. IBM and small EDP Systems company directed to disclose in advance product interfaces with respect to media, software, communications and humans.

Article XXI. IBM and small EDP Systems company directed to disclose software interfaces, standardize applications software in high-level languages, and furnish applications software to manufacturers of EDP Systems at no charge for ten years.

Article XXII. IBM and small EDP Systems company directed to sell subassemblies of EDP Equipment to manufacturers of EDP Systems at OEM prices not to exceed a 100% markup on aggregate of projected factory, direct labor, burden and materials for ten years or until shares in submarkets reduce to 35% or less.

Article XXIII. Office products company directed to sell subassemblies of office products equipment to manufacturers of EDP Systems at OEM prices not to exceed a 100% markup on aggregate projected factory, direct labor, burden and materials for ten years.

Article XXIV. IBM and small EDP Systems company report product line revenues and earnings to Antitrust Division.

Article XXV. IBM and small EDP Systems company restrained from interlocking directorates.

Article XXVI. IBM and small EDP Systems company restrained from making price concessions to customers awaiting delivery and installation.

Article XXVII. IBM and small EDP Systems company restrained from price concessions, "free usage" or "buy-backs."

Article XXVIII. IBM and small EDP Systems company restrained from price fixing and market allocation.

Article XXIX. IBM and small EDP Systems company to make their products available on non-discriminatory terms.

Article XXX. IBM and small EDP Systems company restrained from:

(a) Premature announcement.

(b) Penalties and charge backs on sales personnel.
(c) Abusing incentive compensation for sales personnel.
(d) Educational discounts.
(e) Financial support to educational users having more than 50% IBM or small EDP Systems company EDP Equipment.
(f) Marketing EDP Equipment to certain educational users receiving federal support.
(g) Absorbing customer taxes.
(h) Using leasing agreements which cannot be cancelled by 90 days notice.
(i) Discriminating against persons who are customers of other manufacturers of EDP Systems.
(j) Disparagement.
(k) Threats or undue influence on employment of persons interested in competitive EDP Equipment.
(l) Interference with contract.
(m) Prefential deliveries to discourage competition.
(n) Rigging specifications.
(o) Refusal to lease hardware to competitors.
(p) Refusal to license software to competitors or customers of competitors.
(q) Practicing reciprocity.
(r) Promoting sales by emulation or simulation of competitive EDP Systems.
(s) Supporting restricted user organizations.

Article XXXI. IBM and small EDP Systems company restrained from claiming damages for past infringements.

Article XXXII. IBM and small EDP Systems company restrained from acquiring exclusive patent rights.

Article XXXIII. IBM and small EDP Systems company restrained from acquisition of exclusive know-how.

Article XXXIV. IBM and small EDP Systems company restrained from discriminating in patent royalties.

Article XXXV. IBM and small EDP Systems company directed to grant royalty-free licenses under existing patents.

Article XXXVI. IBM and small EDP Systems company directed to grant royalty-free licenses for future patents.

Article XXXVII. IBM and small EDP Systems company restrained from disposing of patents to avoid licensing competitors.

Article XXXVIII. IBM and small EDP Systems company directed to grant foreign patent immunity.

Article XXXIX. IBM and small EDP Systems company restrained from cross-licenses or grant-backs.

Article XL. Right to attack IBM patents.

Article XLI. IBM and small EDP Systems company restrained from making license restrictions.

Article XLII. IBM and small EDP Systems company to file patent applications or publish technical details regarding its inventions.

Article XLIII. IBM and small EDP Systems company directed to disclose know-how.

Article XLIV. IBM and small EDP Systems company restrained from making acquisitions of competitors, suppliers or customers.

Article XLV. IBM and small EDP Systems company directed to dedicate copyrighted subject matter to public.

Article XLVI. IBM and small EDP Systems company restrained from utilizing software to influence hardware sales or to discourage purchases of competitors' hardware and from applying for patents or copyrights on software or demanding payment for testing of software.

Article XLVII. IBM and small EDP Systems company restrained from restricting use of purchased software.

Article XLVIII. IBM and small EDP Systems company directed to dedicate all existing patents and copyrights on software.

Article XLIX. IBM directed to distribute excessive cash and marketable securities.

Article L. Retention of jurisdiction by Court.

Final Judgment

Now, therefore, it is hereby ordered, adjudged, and decreed as follows:

I

The Court has jurisdiction over (i) those of the directors, officers and employees of International Business Machines Corporation, a New York corporation (herein referred to as "IBM"), whose names are specified on Schedule A, (ii) Service Bureau Corporation, a corporation, (iii) Science Research Associates, Inc., a corporation, and (iv) World Trade Corporation, a corporation, based on the submissions by such persons and corporations to the jurisdiction of this Court.

II

For purposes of this Final Judgment:

(a) "IBM Group" is defined to include IBM and/or each Subsidiary (as hereinafter defined).

(b) "Person" is defined as any individual, partnership, trust, estate, corporation, any other entity establishment under the laws of the United States, any state thereof, or any other nation other than the United States (including but not limited to those designated as a Societe Anonyme, a Gessellschafts mit Beschrankters Haftung or a Societe a Responsabilite Limitee) or any combination of the foregoing.

(c) "Subsidiary" is defined to include any corporation, any other entity established under the laws of the United States, or any state thereof, or any nation other than the United States (including but not limited to those designated as a Societe Anonyme, a Gessellschafts mit Beschrankters Haftung, or a Societe a Responsabilite Limitee) or any combination of the foregoing, (i) fifty percent (50%) of the voting shares of capital stock of which is owned or controlled, directly or indirectly, by IBM Group or a Subsidiary (as otherwise defined in this Section [c] and including any subsidiary of a subsidiary regardless of the tier of the subsidiary) of any of the following:

(a) IBM Group;

(b) Any successor to IBM Group; or

(c) Any of the corporations to be created pursuant to the provisions of this Final Judgment;

or (ii) with respect to which any of the following has the right or power, pursuant to contract or otherwise, to exercise management prerogatives:

(a) IBM Group;

(b) Any successor to IBM Group; or

(c) Any of the corporations to be created pursuant to the provisions of this Final Judgment.

(d) "Electronic Data Processing System" (herein referred to as "EDP System") is defined as any apparatus or group of automatically intercommunicating units of apparatus capable of entering, receiving, storing, classifying, computing and/or recording alphabetic and/or numeric data, which systems may include one or more central processing units and one or more storage facilities and has either:

(1) The ability to receive and retain in the storage facilities at least some of the instructions for the data processing operations required, or

(2) Means, in association with storage, inherently capable of receiving and utilizing the alphabetic and/or numeric representation of either the location or the identifying name or number of data in storage to control access to stored data.

(e) "Small EDP Systems" is defined as those EDP Systems the monthly rental or equivalent, including unbundled products and services, if any, of which is less than $5,000. In addition, said Small EDP Systems shall not include any EDP System which exceeds a total simultaneous input/output throughput of not more than two times the performance of IBM's Systems/3 announced as of the date of entry of this Final Judgment. Regardless of current or future organization or practices, Small EDP Systems is not synonymous with either the "Tabulating Machine Business" or "Terminals".

(f) "Large EDP Systems" is defined as those EDP Systems the monthly rental, including unbundled products or services, if any, of which is more than $5,000.

(g) "Terminals" is defined as any devices which are remotely interconnected to EDP systems primarily to facilitate input or output access by computer operators to such systems; the said terminal devices include, by way of example, keyboards, nonpermanent displays, print mechanisms, card and badge devices.

(h) "Electronic Data Processing Equipment" (herein referred to as "EDP Equipment") is defined as any unitary apparatus, machine or device and attachments therefor designed to be used directly or indirectly in or with an EDP System.

(i) "Communications Equipment" is defined as any data handling apparatus designed to serve as a communication link, or a control therefor, or part thereof, between two or more remotely positioned items of EDP Equipment or between EDP Equipment and/or some data source or data output; said apparatus to include, by way of example, data terminals, modems, switching units, data concentrators, communication control equipment, and remote batch processors.

(j) "Software" is defined as a combination of computer operation or control instructions assembled for use in a computer program, or part thereof, a compiler, assembler, executive or control routine, application package and the like, each or any of which is primarily adapted for use in controlling the operation of an EDP System or EDP Equipment.

(k) "Operating Software" is defined as "Software" which consists of an integrated collection of computer instructions that direct an EDP System's selection, movement, and processing of programs and data needed to solve problems.

(l) "Applications Software" is defined as "Software" the primary purpose of which is to control a computer to process a particular problem of the user of the computer.

(m) "Device Specific Software" is defined as "Software" which is written to perform application-independent functions, including diagnosis and maintenance, and which does not include "Applications Software".

(n) "Functional Utility Software" is defined as "Software" written to perform application-independent functions which are called for by the user and/or other "Software," including functions such as data transcription, routine from one media to another, sorts, mergers and those arithmetic functions which are not built into a given central processor, such as decimal arithmetic.

(o) "Firmware" is defined as any method of deriving the signals called for in the "Software" definition above to accomplish the functional equivalent of such "Software" which is generally not accessible to or changeable by the user.

(p) "Tabulating Machine Business" is defined as the business which makes, uses, leases, sells and/or services tabulating cards, tabulating card machinery and/or tabulating systems to enter, convert, receive, classify, compute and/or record alphabetic, numerical and/or statistical data; which said tabulating cards are used for storing data and communicating it with and within the machinery or system; provided that such business does not make, use, lease, sell or service EDP Systems, EDP Equipment, Communication Equipment and/or Software.

(q) "Industrial Property" is defined as inventions, patents, patent applications, patent licenses, trademarks, applications for trademarks, copyrights, applications for copyrights, trade names, and Technical Information (as hereinafter defined).

(r) "Technical Information" is defined to include all right, title and interest of IBM Group or Small EDP Systems Company in and to all technical information and all know-how, written or unwritten, with respect to research, development, engineering, design, quality control, testing, production and maintenance, which in any way relates to an EDP system, EDP equipment, Communications Equipment or Software, including but not limited to, all documents (including but not limited to schematic drawings, detailed working drawings, specifications of materials, production methods, quality control procedures, manuals, assembly drawings, maintenance documentation, software documentation, and any and all other drawings, specifications and documents of any kind whatsoever) relating to the foregoing, and including the identification of all Persons who supply to IBM Group or Small EDP Systems Company technical information, know-how, materials, equipment, machinery and facilities.

(s) "Existing Patents" is defined as all patents issued on or prior to the date of entry of this Final Judgment, by the United States or by any other nation to IBM Group or Small EDP Systems Company and all patent applications filed on or prior to such date by IBM Group or Small EDP Systems Company in the United States or any other nation, including all divisions, continuations, reissues or extensions of such patents and applications which relate to an EDP system, EDP Equipment, Communications Equipment or Software.

(t) "Future Patents" is defined as all patents issued within the period of ten years to commence on the day following the date of entry of this Final Judgment, by the United States or by any other nation to IBM Group or Small EDP Systems Company, and all patent applications filed, within the said ten year period, by IBM Group or Small EDP Systems Company in the United States or any other nation, including all divisions, continuations, reissues or extensions of such patents and applications which relate to an EDP system, EDP equipment, Communications equipment or Software.

III

(a) IBM shall incorporate, under the laws of the State of Delaware, a new corporation (herein referred to as the "Service Bureau Company"), the name of which shall be entirely dissimilar to "Service Bureau Corporation," "IBM" or "World Trade Corporation", all of the shares of which shall be initially owned by IBM, and IBM Group shall transfer to said newly formed Service Bureau Company all of the shares of the capital stock and all of the assets of Service Bureau Corporation and Science Research Associates and all of the assets of IBM Group, including World Trade Corporation, relating to its service bureau operations, network services operations, unbundled systems engineering operations, educational services operations and U.S.A. federal systems assembly marketing and maintenance operations.

The assets to be so transferred to Service Bureau Company shall include, but not by way of limitation, Industrial Property, all assets, tangible and intangible, relating to research, design, development, quality control, testing, marketing and materials or services procurement activities. Included in the assets to be transferred by IBM Group shall be an amount of cash adequate to meet the needs of Service Bureau Company for working capital, capital, and other expenditures up until such time that the earnings of such corporation will be adequate to meet such needs. Service Bureau Company shall be staffed with managerial and other personnel to an extent and in a manner reasonably necessary to enable Service Bureau Company to compete in the relevant markets in which it will be engaged. IBM Group is directed to do everything reasonably possible to transfer to Service Bureau Company managerial and other personnel, presently employed by IBM Group, so as to staff Service Bureau Company in the aforementioned manner.

(b) IBM Group is ordered and directed to take such other actions and enter into such arrangements that are reasonably necessary to enable Service Bureau Corporation to effectively compete in the relevant markets in which it will be engaged during the period following its incorporation.

(c) IBM is hereby ordered and directed to divest itself of all of the shares of capital stock of Service Bureau Company by distributing such shares to the stockholders of IBM. The said divestiture (together with everything else hereinbefore provided by this Article III) shall be completed by not later than one year from the date of entry of this Final Judgment.

(d) Those of the directors, officers and employees in an executive capacity of IBM Group whose names are specified on Schedule A are ordered and directed, upon receipt by them of any shares of the capital stock of Service Bureau Company, pursuant to the aforementioned divestiture, to promptly divest themselves of all such shares and are enjoined and restrained from owning, directly or indirectly, at any time, any shares of the capital stock of Service Bureau Company.

(e) IBM Group is enjoined and restrained from acquiring, directly or indirectly, any shares of the capital stock of Service Bureau Company.

(f) IBM Group is enjoined and restrained from employing, directly or indirectly, an officer or employee in an executive capacity or permitting to serve on its board of directors any person who at any time has served as a director, officer or employee in an executive capacity of Service Bureau Company.

(g) Service Bureau Company is enjoined and restrained from employing, directly or indirectly, an officer or employee in an executive capacity or permitting to serve on its board of directors any person who at any time has served as a director, officer or employee in an executive capacity of IBM Group.

IV

Service Bureau Company is enjoined and restrained from engaging, directly or indirectly, in the manufacture, sale or lease of EDP Systems, EDP Equipment or Communications Equipment until such time that the portion of EDP Systems and EDP Equipment owned or otherwise utilized by Service Bureau Company in

the conduct of its business which has been manufactured, sold, leased or otherwise furnished by IBM or Small EDP Systems Company (as defined hereinafter in Article IX) constitutes less than thirty-five percent of the entire EDP Systems and Equipment owned or utilized by Service Bureau Company; provided, however, that in no event may Service Bureau Company engage, directly or indirectly, in the manufacture, sale or lease of EDP Systems, EDP Equipment or Communications Equipment during the period of ten years to commence with the date of entry of this Final Judgment.

For the said ten year period, IBM Group and Small EDP Systems Company are enjoined and restrained from purchasing, leasing or otherwise acquiring from Service Bureau Company any service or asset without first having received the approval of this Court and only upon the same prices, terms and conditions of sale offered to other manufacturers of EDP Systems and EDP Equipment.

V

(a) IBM shall incorporate, under the laws of the State of Delaware, a new corporation (herein referred to as the "Components Company"), the name of which shall be entirely dissimilar to "IBM" or "World Trade Corporation," all of the shares of which shall be initially owned by IBM, and IBM Group shall transfer to said newly formed Components Company all of the assets of the Components Division of IBM, all of the assets of IBM Group utilized in or related to the other semiconductor and elemental component research, development and manufacturing operations of IBM, and all of the assets of all comparable component research, development and manufacturing operations of World Trade Corporation. The assets to be so transferred to Components Company shall include, but not by way of limitation. Industrial Property, all assets, tangible and intangible, relating to research, design, development, quality control, testing, and marketing and materials or services procurement activities. Included in the assets to be transferred by IBM Group shall be an amount of cash adequate to meet the needs of Components Company for working capital, capital, and other expenditures up until such time that the earnings of such corporation will be adequate to meet such needs. Components Company shall be staffed with managerial and other personnel to an extent and in a manner reasonably necessary to enable Components Company to compete in the relevant markets in which it will be engaged. IBM Group is directed to do everything reasonably possible to transfer to Components Company managerial and other personnel, presently employed by IBM Group, so as to staff Components Company in the aforementioned manner.

(b) IBM Group is ordered and directed to take such other actions and enter into such arrangements that are reasonably necessary to enable Components Company to effectively compete in the relevant markets in which it will be engaged during the period following its incorporation.

(c) IBM is hereby ordered and directed to divest itself of all of the shares of capital stock of Components Company by distributing such shares to the stockholders of IBM. The said divestiture (together with everything else hereinbefore provided by this Article V) shall be completed by not later than one year from the date of entry of this Final Judgment.

(d) Those of the directors, officers and employees in an executive capacity of IBM Group whose names are specified on Schedule A are ordered and directed, upon receipt by them of any shares of the capital stock of Components Company, pursuant to the aforementioned divestiture, to promptly divest themselves of all such shares and are enjoined and restrained from owning, directly or indirectly, at any time, any shares of the capital stock of Components Company.

(e) IBM Group is enjoined and restrained from acquiring, directly or indirectly, any shares of the capital stock of Components Company.

(f) IBM Group is enjoined and restrained from employing, directly or indirectly, an officer or employee in an executive capacity or permitting to serve on its board of directors any person who at any time has served as a director, officer or employee in an executive capacity of Components Company.

(g) Components Company is enjoined and restrained from employing, directly or indirectly, an officer or employee in an executive capacity or permitting to serve on its board of directors any person who at any time has served as a director, officer or employee in an executive capacity of IBM Group.

VI

During the period of ten years beginning one year after date of entry of this Final Judgment, Components Company is enjoined and restrained from selling, leasing or otherwise furnishing to IBM, IBM Group, or to Small EDP Systems Company more than 50% of the annual requirements for semiconductors and other computer components of either IBM, IBM Group, or Small EDP Systems Company (to which reference is hereinafter made). During the said ten-year period, Components Company shall not produce, or refuse to sell to others, any products on the basis that such products are proprietary to IBM Group or the said Small EDP Systems Company and shall make available to other Persons who manufacture EDP Systems all products produced for IBM Group or Small EDP Systems Company at the same prices, terms and conditions of sale that are available to IBM Group and Small EDP Systems Company; *Provided, however*, that Components Company, in determining its prices, may make due allowance for differences in the cost of manufacture, sale or delivery resulting from the differing methods or quantities in which such commodities are sold or delivered to such purchasers, *Provided further*, however, that no quantity discounts offered by Components Company are such that, in fact, they can be realistically utilized only by IBM Group or Small EDP Systems Company.

VII

(a) IBM shall incorporate, under the laws of the State of Delaware, a new corporation (hereinafter referred to as "Office Products Company"), the name of which shall be entirely dissimilar to "IBM" and "World Trade Corporation", all of the shares of which shall be initially owned by IBM, and IBM Group shall transfer to Office Products Company all of the assets of the Office Products Division, Information Records Division and other word processing, office products and information records research, development, manufacturing and marketing operations of IBM and World Trade Corporation. The assets to be so transferred to Office Products Company shall include, but not by way of limitation, Industrial Property, all assets, tangible and intangible, relating to research, design, development, quality control, testing, marketing and materials or services procurement activities. Included in the assets to be transferred by IBM shall be an amount of cash adequate to meet the needs of Office Products Company for working capital, capital, and other expenditures up until such time that the earnings of such corporation will be adequate to meet such needs. Office Products Company shall be staffed with managerial and other personnel to an extent and in a manner reasonably necessary to enable Office Products Company to compete in the relevant markets in which it will be engaged. IBM Group is directed to do everything reasonably possible to transfer to Office Products Company managerial and other personnel, presently employed by IBM, so as to staff Office Products Company in the aforementioned manner.

(b) IBM Group is ordered and directed to take such other actions and enter into such arrangements that are reasonably necessary to enable Office Products Company to effectively compete in the relevant markets in which it will be engaged during the period following its incorporation.

(c) IBM is hereby ordered and directed to divest itself of all of the shares of capital stock of Office Products Company by distributing such shares to the stockholders of IBM. The said divestiture (together with everything else hereinbefore provided by this Article VII) shall be completed by not later than one year from the date of this Final Judgment.

(d) Those of the directors, officers and employees in an executive capacity of IBM whose names are specified on Schedule A are ordered and directed, upon receipt by them of any shares of the capital stock of Office Products Company, pursuant to the aforementioned divestiture, to promptly divest themselves of all such shares and are enjoined and restrained from owning, directly or indirectly, at any time, any shares of the capital stock of Office Products Company.

(f) IBM Group is enjoined and restrained from employing, directly or indirectly, an officer or employee in an executive capacity or permitting to serve on its board of directors any person who at any time has served as a director, officer or employee in an executive capacity of Office Products Company.

(g) Office Products Company is enjoined and restrained from employing, directly or indirectly, an officer or employee in an executive capacity or permitting to serve on its board of directors any person who at any time has served as a director, officer or employee in an executive capacity of IBM Group.

VIII

During the period of ten years to commence with the date of entry of this Final Judgment, Office Products Company is enjoined and restrained from engaging, directly or indirectly, in the manufacture, sale or lease of Communications Equipment.

IX

(a) IBM shall incorporate, under the laws of the State of Delaware, a new corporation (hereunder referred to as "Small EDP Systems Company"), the name of which shall be entirely dissimilar to "IBM" or "World Trade Corporation", all of the shares of which shall be initially owned by IBM, and IBM Group shall transfer to small EDP Systems Company (i) all of the assets of the General Systems Division of IBM, including, but not limited to, all those utilized in or related to Small EDP Systems, Tabulating Machine Equipment and Terminal operations, (ii) that part of the assets of Advanced Systems Division of IBM utilized in or related to Small EDP Systems, Tabulating Machine Equipment and Terminal research, development, manufacturing and marketing operations, and (iii) all the assets of World Trade Corporation utilized in or related to Small EDP Systems, Tabulating Machine Equipment and Terminal research, development, manufacturing and marketing operations. The assets to be so transferred to Small EDP Systems Company shall include, but not by way of limitation, Industrial Property, all assets, tangible and intangible, relating to research, design, development, quality control, testing and marketing activities or to the procurement or furnishing of materials, products and services. Included in the assets to be transferred by IBM shall be an amount of cash adequate to meet the needs of Small EDP Systems Company for working capital, capital and other expenditures up until such time that the earnings of such corporation will be adequate to meet such needs. Small EDP Systems Company shall be staffed with managerial and other personnel to an extent and in a manner reasonably calculated to enable Small EDP Systems Company to compete in the relevant markets in which it will be engaged. IBM Group is directed to do everything reasonably possible to transfer to Small EDP Systems Company managerial and other personnel, presently employed by IBM Group, so as to staff Small EDP Systems Company in the aforementioned manner.

(b) IBM Group is ordered and directed to take such other actions and enter into such arrangements that are reasonably necessary to enable Small EDP Systems Company to effectively compete in the relevant markets in which it will be engaged during the period following its incorporation.

(c) IBM is hereby ordered and directed to divest itself of all of the shares of capital stock of Small EDP Systems Company by distributing such shares to the stockholders of IBM. The said divestiture (together with everything else hereinbefore provided by this Article IX) shall be completed by not later than one year from the date of this Final Judgment.

(d) Those of the directors, officers and employees in an executive capacity of IBM whose names are specified on Schedule A are ordered and directed, upon receipt by them of any shares of the capital stock of Small EDP Systems Company, pursuant to the aforementioned divestiture, to promptly divest themselves of all such shares and are enjoined and restrained from owning, directly or indirectly, at any time, any shares of the capital stock of Small EDP Systems Company.

(e) IBM Group is enjoined and restrained from acquiring, directly or indirectly, any capital stock of Small EDP Systems Company.

(f) IBM Group is enjoined and restrained from employing, directly or indirectly, an officer or employee in an executive capacity or permitting to serve on its board of directors any person who at any time has served as a director, officer or employee in an executive capacity of Small EDP Systems Company.

(g) Small EDP Systems Company is enjoined and restrained from employing, directly or indirectly, an officer or employee in an executive capacity or permitting to serve on its board of directors any person who at any time has served as a director, officer or employee in an executive capacity of IBM Group.

X

During the period of ten years to follow the date of entry of this Final Judgment and such period thereafter in which the share of Small EDP Systems Company of the Small EDP System Submarket exceeds thirty-five percent, Small EDP Systems Company is enjoined and restrained from engaging, directly or indirectly, in the manufacture, sale or lease of Large EDP Systems.

XI

During the period of ten years to follow the date of entry of this Final Judgment and such period thereafter in which the share of Small EDP Systems Company of the Small EDP System Submarket exceeds thirty-five percent, Small EDP Systems Company is enjoined and restrained from engaging, directly or indirectly, in the manufacture, sale or lease of Communications Equipment (except Terminals).

XII

During the period of ten years after the date of entry of this Final Judgment and such period thereafter in which the share of Small EDP Systems Company of the Small EDP System Submarket exceeds thirty-five percent, Small EDP Systems Company is enjoined and restrained from engaging, directly or indirectly, in the manufacture, sale, lease or furnishing of products or services of the type made or furnished by Components Company, Office Products Company or Service Bureau Company.

XIII

Small EDP Systems Company is hereby ordered and directed to reduce its share of the Small EDP System Submarket to fifty percent or less within five years and thirty-five percent or less within ten years from the date of entry of this Final Judgment; jurisdiction is retained by this Court for the purpose of providing further appropriate structural and behavioral relief against Small EDP Systems Company in the event it fails to so reduce its share of said Submarket.

XIV

IBM Group shall retain, under and subject to the jurisdiction and supervision of this Court, all assets which it is not required to divest by Articles III, V, VII and IX, and IBM Group is hereby ordered and directed to reduce its share of the Large EDP System Submarket to fifty percent or less within five years and thirty-five percent or less within ten years from the date of entry of this Final Judgment; jurisdiction is retained by this Court for the purpose of providing further appropriate structural and behavioral relief against IBM Group in the event it fails to so reduce its share of said Submarket.

XV

During the period of ten years after the date of entry of this Final Judgment and such period thereafter in which the share of IBM Group of the Large EDP System Submarket exceeds thirty-five percent, IBM Group is enjoined and restrained from engaging, directly or indirectly, in the manufacture, sale or lease of Small EDP Systems.

XVI

During the period of ten years after the date of entry of this Final Judgment and such period thereafter in which the share of IBM Group in the Large EDP System Submarket exceeds thirty-five percent, IBM Group is enjoined and restrained from engaging, directly or indirectly, in the manufacture, sale or lease of Communications Equipment.

XVII

During the period of ten years after the date of entry of this Final Judgment and such period thereafter in which the share of IBM Group in the Large EDP System Submarket exceeds thirty-five percent, IBM Group is enjoined and restrained from engaging, directly or indirectly, in the manufacture, sale, lease or furnishing of products or services of the type made or furnished by Service Bureau Company, Components Company and Office Products Company.

XVIII

Each of Service Bureau Company, Components Company and Office Products Company is enjoined and restrained from purchasing, leasing or otherwise obtaining, within any year of the ten-year period after the date of entry of this Final Judgment, more than thirty-five percent of its requirements for EDP Systems or EDP Equipment from IBM Group or Smoll EDP Systems Company.

XIX

(a) IBM Group and Small EDP Systems Company are hereby ordered and directed within 12 months from the date of entry of this Final Judgment to produce a type of connection to effectively and fully utilize the EDP Systems of IBM Group and Small EDP Systems Company with Communications Equipment designed or produced by Persons engaged in the design, research, development, production, sale or lease of EDP Systems, EDP Equipment, Communications Equipment, Terminals or Software.

(b) Small EDP Systems Company is hereby ordered and directed within 12 months from the date of entry of this Final Judgment to produce various types of connections to effectively and fully utilize the EDP Systems of IBM Group and other Persons engaged in the design, research, development, production, sale and lease of EDP Systems with the Terminals of Small EDP Systems Company.

(c) Unless the consent of this Court is first obtained, during the period of ten years to commence on the date of entry of this Final Judgment, IBM Group and Small EDP Systems Company are enjoined and restrained from making any changes in or modification of the connections to which reference is made in Sections (a) and (b) of this Article XIX.

XX

(a) During the period of ten years to commence with the date of entry of this Final Judgment and such period thereafter in which the share of IBM Group in the large EDP System Submarket exceeds thirty-five percent, IBM Group is ordered and directed to make disclosures as provided by Section (c) of this Article XX. The disclosures with respect to procedures and techniques that may be utilized with hardware, Software or combinations thereof (sometimes referred to as "firmware") to define the operations of each aspect of any new "computer language" incorporated in the applicable Software, shall be made at least 60 months prior to such time that such procedures and techniques are made available. All other disclosures shall be made at least 24 months prior to such time that IBM Group makes available by sale, lease, license or otherwise, any new product, device, procedure related to any such product or device, or any modifications of any products. devices or procedures.

(b) During the period of ten years to commence with the date of entry of this Final Judgment and such period thereafter in which the share of Small EDP Systems Company in the Small EDP System Submarket exceeds thirty-five percent. Small EDP Systems Company is ordered and directed to make disclosures as provided by Section (c) of this Article XX. The disclosures with respect to procedures and techniques that may be utilized with hardware, Software or combinations thereof (sometimes referred to as "firmware"), to define the operations of each aspect of any new "computer language" incorporated in the applicable Software, shall be made at least 60 months prior to such time that such procedures and techniques are made available. All other disclosures shall be made at least 24 months prior to such time that Small EDP Systems Company makes available by sale, lease, license, or otherwise, any new product, device, procedure related to any such product or device, or any modifications of any products, devices or procedures.

(c) The disclosures provided by this Article XX shall be made to all Persons engaged in the research, design, development, production and lease of EDP Systems, EDP Equipment, Communications Equipment, Terminals and Software and shall consist of (i) comprehensive written materials to be delivered to all such Persons and (ii) assistance to be rendered at reasonable times to all such Persons by qualified employees of IBM Group or Small EDP Systems Company, as the case may be, which would provide to persons trained in the applicable arts adequate information to enable them to effectively and fully utilize the EDP Systems, EDP Equipment, Communications Equipment and Software of the aforementioned Persons with all EDP Systems, EDP Equip-

ment, Communications Equipment, Software and other products, devices, services and procedures which are sold, leased, licensed or otherwise made available by IBM Group and Small EDP Systems Company, respectively. The disclosures must include, by way of example and not by way of limitation, (i) data regarding dimensions, recording density, track spacing, record identification and other descriptive data with respect to discs, tapes, cards and other media products; (ii) procedures and techniques that may be utilized with respect to hardware, Software or combinations thereof (sometimes referred to as "firmware"), to define the operations of each aspect of the "computer language" incorporated in the applicable Software; (iii) physical and logical data formats, control routines and data codes, with respect to communications; and (iv) job control, formats and procedures with respect to the human/EDP System dialogue required to operate such system effectively.

XXI

(a) During the period of ten years to commence with the date of entry of this Final Judgment and such period thereafter in which the share of IBM Group in the Large EDP System Submarket exceeds thirty-five percent, IBM Group is ordered and directed to make disclosures as provided by Section (c) of this Article XXI.

(b) During the period of ten years to commence with the date of entry of this Final Judgment and such period thereafter in which the share of Small EDP Systems Company in the Small EDP System Submarket exceeds thirty-five percent, Small EDP Systems Company is ordered and directed to make disclosures as provided by Section (c) of this Article XXI.

(c) The disclosures provided by this Article XXI shall be made to all Persons engaged in the manufacture of EDP Systems and shall consist of (i) comprehensive written materials to be delivered to all such Persons, and (ii) assistance to be rendered at reasonable time to all such Persons by qualified employees of IBM Group or Small EDP Systems Company, as the case may be, which disclose all of the Applications Software, together with all modifications and improvements made to said Applications Software from time to time, which is owned by IBM Group or Small EDP Systems Company, as the case may be, or otherwise in the possession of either such company with attendant rights to sublicense and which is utilized with EDP Systems, EDP Equipment, Communications Equipment and Terminals manufactured, sold or leased by IBM Group or Small EDP Systems Company, as the case may be. Such disclosures shall be made without the payment of any consideration whatsoever to IBM Group and Small EDP Systems Company, and shall include, but not be limited to, functional specifications explaining the manner in which such aforementioned Applications Software interconnects and works with Operating Software, Functional Utility Software, Firmware and other Applications Software.

(d) During the periods provided in Sections (a)) and (b) above of this Article XXI, IBM Group and Small EDP Systems Company are ordered and directed to produce all future Applications Software in the computer language known as COBOL or a comparable standardized high-level computer language approved by this Court and in a form which is most generally compatible with and operational on EDP Systems manufactured by other Persons. Such Applications Software shall conform to any product standards which have been adopted for that type of application and/or language by American National Standards Institute or by other recognized electronic data processing industry standards groups approved by this Court and IBM Group and Small EDP Systems Company shall refrain from writing any portion of such Applications Software in language deviating from that specified in said product standards unless prior approval of this Court is obtained for deviations on good cause shown. Said product standards to be conformed to by IBM Group and Small EDP Systems Company pursuant to this Article XXI shall include, but not be limited to, standards for file structures, data communications, message formats, and job control formats and procedures with respect to the human/EDP system dialogue, wherever possible.

(e) All Applications Software now owned or otherwise possessed with rights to sublicense by IBM Group or Small EDP Systems Company and all such Applications Software which during the ten-year period following the date of entry of this Final Judgment is produced, owned or otherwise comes into the possession of IBM Group or Small EDP Systems Company with rights to sublicense shall be reproduced and furnished in the form specified above in

Section (d) of this Article XXI upon request to all Persons who manufacture EDP Systems, at no charge and with full rights for said Persons to use, resell or otherwise sublicense the use of such Applications Software.

(f) IBM Group and Small EDP Systems Company are ordered and directed to provide to all Persons who have obtained Applications Software pursuant to Section (e) above of this Article XXI all written materials and other assistance which may be necessary to make error connections in or improvements and modifications to any Applications Software furnished said Persons for a period of at least five years from the date of each item of such Applications Software was initially made available by IBM or Small EDP Systems Company for sale, lease or license to end-users and, subject to the foregoing, to notify all Persons receiving Applications Software pursuant to Section (e) above of this Article XXI of its intention to discontinue such error correction and program modification and improvement support for any portion of such Applications Software at least two years prior to the effective date of such discontinuance.

(g) If any Applications Software furnished to any Person pursuant to this Article XXI requires special implementation on or with EDP Equipment. Terminals or other devices manufactured by either IBM Group or Small EDP Systems Company in order to effectively utilize its capabilities, then and in that event IBM Group and Small EDP Systems Company are ordered and directed to sell or otherwise make available such EDP Systems, Terminals and devices to such Persons under the provisions for OEM purchasing specified in Article XXII of this Final Judgment.

XXII

IBM Group and Small EDP Systems Company are hereby ordered and directed, for a period of ten years from the date of entry of this Final Judgment and such period thereafter in which their respective shares in the Large EDP System and Small EDP System Submarkets exceed thirty-five percent, to announce and make available for sale to all manufacturers of EDP Systems, at a time no later than the corresponding related commercial announcement, reasonable portion assembly or subassembly of any of its EDP Equipment at prices to be designated as original equipment manufacturer (OEM) prices and calculated as follows: 2X the sum of projected factory, direct labor, burden and materials costs for each such type of EDP Equipment. IBM Group and Small EDP Systems Company shall manufacture and/or ship such devices ordered by other manufacturers of EDP Systems in the order in which such purchase orders are received, regularly intermingling them with purchase from all other customers.

XXIII

Office Products Company is hereby ordered and directed, for a period of ten years from date of entry of this Final Judgment, to announce and make available for sale to all manufacturers of EDP Systems, at a time no later than the corresponding related commercial announcement, reasonable portion assembly or subassembly of any of its office product equipment at prices to be designated as original equipment manufacturers (OEM) prices and calculated as follows: 2X the sum of projected factory, direct labor, burden and materials costs for each such type of office products equipment.

Office Products Company shall manufacturer and/or ship such devices ordered in the order in which such purchase orders are received, regularly intermingling them with purchase orders from all other customers.

XXIV

Within thirty days after each calendar quarter included in the period of ten years to commence with the date of entry of this Final Judgment, IBM and Small EDP Systems Company shall submit to the Antitrust Division of the United States Department of Justice a written report of their respective (i) total sales and revenues, and (ii) income (or loss) before income taxes segregated between U.S. and other, and extraordinary items attributable to each of the following:

(a) each of their respective product lines

(b) each of their respective lines of business

The said sales, revenues and income (or loss) figures shall be shown separately for each product line and each line of business for both the U.S. and other.

If there is in effect, at the time any such report is so required to be submitted to the Antitrust Division, a requirement that a corporation filing a registration statement or a report with the United States Securities and Exchange Commission report separate sales, revenue and income (or loss) figures for each of its product lines and for each of its lines of business, then, in that event, the definitions of product line and line of business utilized for that purpose shall be utilized in determining the product lines and lines of business concerning which IBM is to file its aforementioned reports with the Antitrust Division. The Antitrust Division shall give a copy of each such report, submitted to it by IBM and Small EDP Systems Company to each Person engaged in producing, selling or leasing any EDP System, EDP Equipment or Software who makes a request for such report.

XXV

(a) IBM and Small EDP Systems Company are hereby respectively enjoined and restrained from permitting any Person who is a director, officer or employee in an executive capacity of any other Person which is its supplier, customer or significant competitor to serve as a director on its board or as its officer or employee in an executive capacity. No officer or employee in an executive capacity of IBM or Small EDP Systems Company shall be a director, officer or employee in an executive capacity of any other Person.

(b) No director of IBM or Small EDP Systems Company shall influence the selection by any Person of EDP Equipment manufactured by IBM or Small EDP Systems Company respectively.

XXVI

IBM and Small EDP Systems Company are respectively enjoined and restrained from offering, directly or indirectly, to make available any price, discount, rebate, or other concession or incentive to any Person who is awaiting the delivery or the completion of installation of any equipment, product, or service produced, furnished or leased by IBM or Small EDP Systems Company as an inducement to such user to acquire, lease or otherwise obtain from IBM or Small EDP Systems Company, any EDP System, EDP Equipment or Software.

XXVII

IBM and Small EDP Systems Company are respectively enjoined and restrained from offering, directly or indirectly, to any Person (i) prices which are lower than those offered to its other customers, (ii) any allowance, discount, rebate or other concession of any kind whatsoever not offered generally to all of its customers, (iii) any "free usage" of EDP Systems or EDP Equipment, or (iv) to negotiate, for any purpose, "buy-back" of EDP Systems or EDP Equipment use time.

XXVIII

IBM and Small EDP Systems Company are respectively enjoined and restrained from directly or indirectly entering into, adhering to, enforcing or claiming any rights under any term or provision of any contract, agreement, or understanding between or among its actual or potential competitors, which term or provision or understanding:

(1) Allocates territories, customers or markets; or

(2) Establishes prices or terms for the manufacture, use, sale or lease of any EDP System, EDP Equipment or Software, other than purchase, sale or lease transactions between competitors in the normal course of business.

XXIX

IBM and Small EDP Systems Company are respectively ordered and directed to make new products, or products under new names, fully available on nondiscriminatory terms to all customers of the same general category located in the United States; provided, however, that such customers must comply with IBM's and Small EDP Systems Company's reasonable and uniform standards of credit.

XXX

IBM and Small EDP Systems Company are respectively enjoined and restrained from directly or indirectly:

(a) Making any (i) advertisement or announcement concerning a proposed new item of Software, EDP System or EDP Equipment prior to such time that

it has available a tested working model of the EDP System or EDP Equipment or the Software has been completed and available for delivery to at least one customer, or (ii) other premature advertisement or announcement of any new Software, EDP System or EDP Equipment, the consequence of which would be to deter the acquisition of Software, EDP System or EDP Equipment from any Person other than IBM or Small EDP Systems Company respectively.

(b) Imposing on its marketing or other personnel quotas, penalties (financial or otherwise) or "charge-backs" based on either a netting or a loss of orders, customers, or bookings, the consequence of which may be to encourage such personnel to engage in predatory or unfair trade practices;

(c) Utilizing any marketing incentive program under which (i) more than ten percent of the total compensation of an employee is based on the sales or leases generated by his efforts or (ii) the compensation of an employee is reduced or "netted" by reason of the return by a customer of equipment previously sold, delivered or installed;

(d) Offering to sell, lease or deliver Software, new or used EDP Systems or EDP Equipment to an educational institution at prices or rental less than those offered to other customers;

(e) Selling or leasing further Software, EDP Systems or EDP Equipment to any educational institution whose aggregation of such equipment is more than 50% of IBM or Small EDP Systems Company manufacture and which is receiving, directly or indirectly, any grant, loan or other support from IBM or Small EDP Systems Company respectively.

(f) Offering to sell, lease, license or deliver Software, EDP Systems or EDP Equipment to any educational institution whose aggregation of such equipment is more than 50% of IBM or Small EDP Systems Company manufacture and which is receiving, directly or indirectly, any funds from the United States Government, or any agency or department thereof, by reason of the use of such Software, EDP Systems or EDP Equipment for training or other educational purposes;

(g) Making payment for any personal property, sale, use, lease or other tax levied on Software, EDP Systems or EDP Equipment marketed by it to a customer without passing such tax on to such customer;

(h) Entering into or continuing to enforce any agreement pertaining to the lease of an EDP System or EDP Equipment or the license of Software which cannot be cancelled by the lessee by giving 90 days prior written notice to IBM or Small EDP Systems Company respectively;

(i) Declining to sell or lease or causing a delay in the delivery of any equipment or the providing of services to a customer because of the customer's acquisition of equipment or services from another supplier;

(j) Disparaging or falsely representing any product, service or capability of any other Person;

(k) Threatening or attempting to exert an unfavorable influence with respect to the employment of any Person because of his interest in the equipment or services of any Person other than IBM or Small EDP Systems Company respectively;

(l) Interfering with any contract involving the purchase or lease of any equipment or services of any other Person;

(m) Rearranging in any instance the delivery schedules for its Software, EDP Systems or EDP Equipment for the purpose of offering to grant a delivery preference in an effort to deter a sale, lease or license of Software, EDP Systems, EDP Equipment, Communications Equipment or services of any other Person;

(n) Participating in or inducing the drafting of specifications for Software, EDP Systems, EDP Equipment or Communications Equipment for the purpose of persuading a prospective customer to acquire Software, EDP Systems, EDP Equipment or services from IBM or Small EDP Systems Company respectively to the exclusion of those of comparable kind and quality of other Persons;

(o) Declining to lease (as distinguished from a sale) its EDP Systems, EDP Equipment or Communications Equipment to any Person who is in competition with IBM or Small EDP Systems Company;

(p) Declining to license its Software to customers of Persons in competition with IBM or Small EDP Systems Company, respectively, with full rights to sublicense to subsidiaries and affiliates;

(q) Purchasing products and services from other persons on the condition or understanding that such purchase depends on past or future purchase by that person of products or services from IBM or Small EDP Systems Company respectively or from otherwise promoting the sale of IBM or Small EDP Systems

Company products or services through reciprocal dealing or other utilization of the purchasing power of IBM or Small EDP Systems Company respectively; no list or other compilation which identifies suppliers and provides information with respect to their sales to IBM or Small EDP Systems Company shall be utilized by or made available to any officer or employee of IBM or Small EDP Systems Company who has a sales responsibility; and no list or other compilation which identifies customers and provides information with respect to their purchases from the IBM or Small EDP Systems Company shall be utilized by or made available to any officer or employee who has a purchasing responsibility.

(r) Proposing or offering to a customer or prospective customer the availability of or efficacy of any conversion aides or other devices which are designed to enable the EDP Systems or EDP Equipment of IBM Group or Small EDP Systems Company to emulate or simulate the operation of EDP Systems or EDP Equipment of other manufacturers, and from in any way enhancing its existing technical capability to emulate or simulate EDP Systems and EDP Equipment manufactured by other Persons.

(s) Attending or participating in or furnishing financial and other support to any meeting of organization of EDP System users or prospective customers if the attendance or membership of such group is restricted in any way according to EDP Systems of any particular manufacturer(s).

XXXI.

IBM Group and Small EDP Systems Company are hereby each enjoined and restrained from claiming, directly or indirectly, any damages in any pending or future patent litigation for an act of infringement of Existing Patents alleged to have occurred prior to the date of entry of this Final Judgment.

XXXII.

IBM Group and Small EDP Systems Company are hereby enjoined and restrained during the period of ten years to commence with the date of entry of this Final Judgment from acquiring from any Person (i) any patent issued by the United States or any other nation relating to any EDP System, EDP Equipment, Communications Equipment or Software, (ii) an assignment of an application for a patent relating to any EDP System, EDP Equipment, Communications Equipment or Software, filed in the United States or any other nation, (iii) any exclusive license or other exclusive right with respect to any such patent or patent application and (iv) any immunity from suit for infringement of any such patent or any patent issued under any such application unless such immunity is granted under the same terms to other Persons requesting such immunity, provided, however, that the foregoing provisions of this Article shall not be applicable to patents or applications for patents relating to the invention of any person made during the course of his employment as a bona fide employee of IBM Group or Small EDP Systems Company or to patents relating to the inventions of professional research consultants who were employed by IBM Group or Small EDP Systems Company to engage in activities which are the basis for such inventions.

XXXIII

IBM Group and Small EDP Systems Company are enjoined and restrained during the period of ten years to commence with the date of entry of this Final Judgment from acquiring from any Person Technical Information unless such Technical Information is made available on the same terms to all Persons engaged in research or development with respect to, or the production, sale or lease of EDP Systems, EDP Equipment, Communications Equipment, or Software.

XXXIV

IBM Group and Small EDP Systems Company are hereby enjoined and restrained from becoming a party to, performing or utilizing any right provided by, any contract, agreement, arrangement, understanding, plan or program pursuant to which there had been made available to IBM Group or Small EDP Systems Company any license or other rights with respect to any patent issued by the United States or any other nation or any application for any such patent at lower royalty rates or other consideration that have been or would be made available to any Person engaged in the research, development, production, sale or lease of EDP Systems, EDP Equipment, Communications Equipment or Soft-

ware, or any such license or other rights which would not have been made available to all such other Persons.

XXXV

IBM Group and Small EDP Systems Company are hereby ordered and directed to grant to any Person resident or domiciled in the United States who is engaged in research or development with respect to, or the production, manufacture, sale or lease of EDP Systems, EDP Equipment, Communications Equipment or Software, or to any Subsidiary of any such Person, who makes a written application therefor, an unrestricted, non-exclusive, non-discriminatory and royalty-free license to make, have made, use, lease and sell under and for the full unexpired term of any one or more Existing Patents and in addition, to make available to such licensee, without the payment of any other fee or other consideration, all Technical Information relating thereto.

XXXVI

IBM Group and Small EDP Systems Company are hereby ordered and directed to grant to any Person resident or domiciled in the United States who is engaged in research or development with respect to, or the production, manufacture, sale or lease of EDP Systems, EDP Equipment, Communications Equipment or Software, or to any Subsidiary of any such Person, who makes a written application therefor, an unrestricted, non-exclusive, non-discriminatory and royalty-free license to make, have made, use, lease and sell under and for the full unexpired term of any one or more Future Patents and, in addition, to make available to such licensee, without the payment of any other fee or other consideration, all Technical Information relating thereto.

XXXVII

IBM Group and Small EDP Systems Company are hereby enjoined and restricted from making any sale or other disposition of any Existing Patent or any Future Patent which would preclude or adversely affect their right to grant licenses pursuant to Article XXXV or Article XXXVI unless each Person to whom there is any such sale or disposition files, in advance of such sale or disposition, with this Court his agreement that any such sale or disposition is subject to the foregoing and that he will do whatever may be required, including the execution of all necessary instruments, to insure that licenses in accordance with the foregoing will be granted to such such applicant.

XXXVIII

IMB Group and Small EDP Systems Company are hereby ordered and directed upon written request from a licensee, pursuant to a license granted under Article XXXV or Article XXXVI, to grant to such licensee, and without the payment of consideration by such licensee, a non-exclusive grant of immunity from suit with respect to any corresponding patent issued by a nation other than the United States, or any application with respect to any such patent, of IBM Group.

XXXIX

IBM Group and Small EDP Systems Company are hereby enjoined and restrained from effecting any requirement that, as a condition to the grant by it of a license pursuant to Article XXXV or Article XXXVI, the licensee cross-license or otherwise license any patent to IBM Group or that there be granted to IBM Group any patent, or application for patent, of the licensee which is relevant, as an improvement or otherwise, to the patent of IBM Group licensed to the licensee.

XL

No Person who is a licensee, pursuant to Article XXXV or Article XXXVI, is precluded from contesting the validity or scope of any patent of IBM Group or Small EDP Systems Company. Nothing contained in this Final Judgment shall be construed to impute the validity of any patent of IBM Group or Small EDP Systems Company.

XLI

Except for the following, no license granted by IBM Group or Small EDP Systems Company pursuant to Article XXXV or Article XXXVI shall contain any condition, restriction or covenant:

(1) The covenant of IBM Group or Small EDP Systems Company to grant the license for the licensee to make, have made, use, lease and sell under the patents for the full unexpired term of the patent and to make available to the licensee all Technical Information relating thereto;

(2) The license may be nontransferable;

(3) The license must provide that the licensee shall have the right to terminate the license at any time after the first year of the term of the license.

XLII

IBM Group and Small EDP Systems Company are hereby ordered and directed either (i) to file patent applications with respect to all inventions made by it or on its behalf at any time during the period of ten years to commence on the date of entry of this Final Judgment, or (ii) to publish and distribute the technical details of such inventions so as to convey to those skilled in the art an understanding thereof and an ability to effectively practice the invention.

XLIII

(a) "Eligible Applicant" is defined for purposes of this Article to be any person (i) who is engaged in research or development with respect to, or the production sale or lease of, EDP Systems, EDP Equipment, Communications Equipment or Software, (ii) who makes written request that he be furnished the Technical Information and the opportunity to utilize the other rights provided by Section (b) of this Article, and (iii) who at the time of making such request makes payment to IBM Group of the sum of $5,000.

(b) During the period of ten years to commence on the date of entry of this Final Judgment, IBM Group and Small EDP Systems Company are ordered and directed (i) to furnish Technical Information to each Eligible Applicant and (ii) to make available to each Eligible Applicant at the principal place of manufacture or IBM Group and Small EDP Systems Company respectively technically qualified employees to disclose such additional Technical Information that will enable the Eligible Applicant to manufacture EDP Systems, EDP Equipment and Communications Equipment and to produce Software, and (iii) to permit each Eligible Applicant to visit the research, development, quality control, testing, production and other facilities of IBM Group or Small EDP Systems Company respectively to observe and be advised with respect to anything pertinent to or that may be of assistance in obtaining an adequate understanding of Technical Information, provided, however, that such visitation rights shall be subject to the following:

(1) Not more than three officers, employees or other representatives of Eligible Applicant shall be permitted to participate in each visit.

(2) Eligible Applicant shall not be authorized to make more than four visits in any calendar year.

(3) Each visit shall be at a time reasonably convenient to IBM Group or Small EDP Systems Company.

XLIV

For a period of ten years from the date of entry of this Final Judgment, IBM Group and Small EDP Systems Company are respectively enjoined from acquiring the whole or any part of the capital stock or any part or all of the EDP System, EDP Equipment or Software assets, other than products purchased in the normal course of business, or (a) any firm engaged in the production, sale or lease of EDP Systems, EDP Equipment or Software; (b) any direct supplier of raw materials to firms engaged in the production, sale or lease of EDP Systems, EDP Equipment or Software; or (c) any direct customer of firms engaged in the production, sale or lease of EDP Systems, EDP Equipment or Software.

XLV

During the period of ten years following the date of entry of this Final Judgment, IBM Group and Small EDP Systems Company are hereby ordered and directed to dedicate to the public any and all copyright subject matter useful for any purpose with respect to the maintenance, operation and/or use of any EDP System or EDP Equipment and is enjoined and restrained from copyrighting any such subject matter.

XLVI

IBM Group and Small EDP Systems Company are hereby enjoined and restrained from;

(a) Utilizing their respective Software marketing programs, including services offered in support thereof, to tie-in or otherwise influence, directly or indirectly, the marketing of their respective EDP Equipment or EDP Systems;

(b) Utilizing their respective Software marketing programs, including services offered in support thereof, to discourage, directly or indirectly, their respective EDP customers or potential customers from acquiring EDP Systems of another manufacturer or supplier;

(c) Imposing any restriction that Software, licensed by them respectively, be utilized on a specific central processor produced them respectively;

(d) Making application for, obtaining, or acquiring during the period of ten years from the date of entry of this Final Judgment, any patent or copyright on Software;

(e) Making any claim or demanding the payment of any royalty, fee, or other consideration based on the testing of their respective Software on any EDP System or EDP Equipment.

XLVII

IBM Group and Small EDP Systems Company are hereby enjoined and restrained from placing any restriction on the use that may be made of Software purchased from them respectively. Without limiting the generality of the foregoing, they shall not place any restriction on any purchaser of their respective Software relating to its use on any EDP System or EDP Equipment and relating to the right of such purchaser to sell or otherwise transfer such Software to others without restriction.

XLVIII

IBM shall dedicate to the public any and all of its Existing Patents and Copyrights on Software.

XLIX

IBM is hereby ordered and directed to distribute to its shareholders and/or otherwise divest itself in a manner which is in the best interests of such shareholders of a sufficient amount of its cash and marketable securities assets (now totaling in excess of $2,300,000,000) so as to reduce such holdings to a level adequate to sustain the ordinary requirements of its business and to avoid the creation of extraordinary surplus; in furtherance thereof, IBM is directed to submit a plan for such distribution and/or divestiture to this Court within thirty days from date of entry of this Final Judgment.

L

Jurisdiction is retained by this Court for the purpose of enabling any of the parties to this Final Judgment to apply to this Court at any time for such further orders and directions as may be necessary or appropriate for the construction or modification of any of the provisions hereof, for the enforcement of compliance herewith, and for the punishment of violations hereof.

The provisions of this Final Judgment shall not be deemed to have any effect on the prior Judgments entered in this Court on December 26, 1935, January 29, 1936 and January 25, 1956 in United States *v.* International Business Machines Corporation, except that the said Small EDP System Company formed pursuant to Article IX above shall be deemed to be a specific party, in addition to IBM, subject to the provisions of said prior judgments to the same extent as is IBM.

Senator HART. Our next witness will be Mr. Christopher Layton. Mr. Layton has come from Brussels for this hearing, and we feel privileged that he will participate.

He is the director responsible for data processing in the EEC.

I think there is evidence that heightens interest and concern and desire that we mutually share our opinions.

Mr. Layton?

STATEMENT OF CHRISTOPHER LAYTON, DIRECTOR RESPONSIBLE FOR DATA PROCESSING, COMMISSION OF EUROPEAN COMMUNITIES

Mr. LAYTON. Mr. Chairman, first may I thank you and your committee for giving me this opportunity to express, on a personal basis and not as an official representative of the Commission, the European view on the great issue you are examining: The structure of the world computer industry.

This is an industry which, as your chairman said, is not merely a key growth industry but the nervous system of a modern economy. And that goes for Europe as well as the United States.

First, a word of history.

The concepts and the intellectual effort which gave birth to the computer industry were, as in so many fields of science, a joint product of American and European minds. This pioneering work of Neumann or the ERA group in the United States was matched in Europe by the work of Zuse in Germany or of the teams in Britain which developed Atlas.

By contrast, there is no doubt that the first major effective industrial and commercial exploitation of data processing took place in the United States. There were several reasons: The higher level of incomes in the United States in the 1950's and 1960's, and the existence of a continental market; the existence of continentwide businesses and management methods better able us to make use of systematic data processing; the major stimulus provided by Federal Government procurement and the ambitious technical requirements of defense and space programs.

All these elements together helped to create a situation in which energetic American companies led the way in exploiting data processing commercially in the United States and then brought their capabilities to Europe. Today, over 80 percent of the computers in use in Europe are based on American technology. And some 60 percent of the European market is in the hands of a single company—IBM. So the structure has many parallels with what you see here in the United States.

Europeans do not begrudge these achievements. Indeed, we respect them and seek to emulate them. Our economies benefit from the transfer of technology and skills which they involve.

History has, however, left effects which inevitably cause us concern. In no other industry is a single firm so dominant. Though IBM has made an immense contribution to the commercial application of data processing, its position "enables it to determine the pattern of prices and standards, to dictate the pace of commercial innovation and the pattern of the market"—to use the Commission's words. Europeans, both as users and competitors, naturally seek to encourage and promote viable, alternative competitive firms.

A second natural concern of Europeans is that they should have some stake of their own in this key industry of the future. By this I mean that at least some company or companies that have an overall systems capability should be European controlled and owned.

Here you may ask why and what does this mean.

The role of data processing in government and administration, in defense, in science, in education, in industrial management—all this

means that this is an industry which does have political importance. Europeans do not seek to exclude U.S. owned and controlled companies in Europe—indeed, they welcome them—but they do seek a share in this key industry. In an expanding market, there is room for both.

For these reasons, three of the largest European countries—Britain, France, and Germany—have with relatively modest resources made efforts to keep a national industry alive.

They have done this by giving some financial support to the research and development programs of three companies: Siemens in West Germany, Compagnie Internationale d'Informatique in France, and International Computers Ltd. in Britain. This help was expected to be worth a total of some $450 million over the 4 years 1971 to 1975. It was thus substantially smaller in scale than the U.S. Government funding of R. & D. in the computer industry through defense and space programs. The OECD estimated this government funding in the United States at some $300 million in 1965.

These efforts have kept alive a European-owned part of the industry, but their limited scale is shown by the fact that in 1972 the four largest European firms together still only had some 6 percent of the world market in terms of installed capacity.

One should add that some of the European nations, conscious that the effective application of data processing to public needs is as important as the existence of a strong industry, have also been fostering this aim by specific programs in the field of applications.

Joined as they are in the European Community, which aspires toward a complete economic and monetary union, it has been natural for the European countries to seek to pursue these objectives by a joint effort. They have been spurred on by the immense economics of scale achieved in this industry, not only in research, development, and production, but in worldwide marketing and applications capability and in financial strength.

A first industrial step to pool limited resources has been taken by the formation of the Unidata group between Philips, Siemens, and CII. This group is now establishing a joint marketing effort and developing a common new range of computers.

A first political step toward a common industrial policy was taken on June 25 of this year when the Council of Ministers of the European Communities passed a resolution, document R1973-74—I will give you a copy of this for the record—with two main themes:

[The document referred to appears as exhibit 1 at the end of Mr. Layton's oral testimony.]

Mr. LAYTON. The need to encourage, by collaboration, the European industry, and collaboration in the ever-growing area of the application of data processing to public needs.

To pursue these objectives, policies in the fields of standards, procurement and other help for the industry were to be given a Community orientation, and the Commission was asked to make proposals for joint support for projects of common interest and of international character in the fields of applications as well as of selected transnational industrial development projects.

In the medium term the aim is to evolve an overall program for the development of data processing in the Community with the central aim of insuring, by the early 1980's, a viable European industry.

Here, for your information, I think it would be useful if I say a few words about the institutions of the European Community. The Council of Ministers from the member countries is the body which ultimately makes decisions on policy. The Commission, of whose staff I am a member, makes policy proposals.

The Council resolution of which I have spoken was based on a longer communication from the Commission which provides a useful background to the resolution, document sec. (73–4300), and I will give you a copy of this document for the record.

[The document referred to appears as exhibit 2 at the end of Mr. Layton's oral testimony.]

Mr. LAYTON. I have painted this broad picture of attitudes and policies in Europe because it seemed a proper framework for discussion of the structure of the computer industry and of our common interests in this field. First, the public interest on both sides of the Atlantic is to avoid monopoly and any abuse of a dominant position. Without disputing the immense contribution IBM has made to data processing, we all have a common interest in insuring that vigorous and viable competitors exist and that they are not hampered by unfair practices.

One of the more effective operational chapters of the treaty setting up the European Economic Community is the rules of competition, which are enforced by the Commission. Article 86 of the treaty empowers the Commission to proceed against a company which "abuses a dominant position." Speaking in a personal capacity—I can't speak in detail for the department of the Commission which has the task of enforcing article 86 of the Rome Treaty—it is quite clear that they have the task of examining very carefully whether IBM does dominate this industry, according to a fair and reasonable definition of the market—and there is much prima facie evidence in this direction—and whether there are concrete cases of abuse.

The case being brought by the Department of Justice and the *Telex* case have aroused a lively interest in Europe and it is clearly the duty of the Commission to see whether the abuses alleged in these cases have parallels in Europe.

I believe there are also real common interests in the wider positive policy we are developing for data processing in Europe. Europe has benefited and still benefits from the technology and skills brought by U.S. data processing companies. We are merely seeking to insure that, side by side with these, European-based companies also play a dynamic part.

I believe the time may come when this could have an interest for the United States. The process of concentration in the industry is moving so fast that the existence of at least one major viable alternative European source of competition, of new ideas and of systems capability is in the interest of American users, in my view. May I stress, too, that the industrial objective of pooling the present aids provided by governments to the European industry is not a permanent subsidy, but to help the European industry to become strong enough to stand on its own feet and compete openly in the markets of the world. It is an attempt to compensate for IBM's head start.

Partnerships between such a European company or companies and American firms other than IBM should not be excluded; indeed it would be in many ways desirable. The one reserve widely shared by

European governments and industry is that such arrangements should not lead to the absorption of the European firm.

The development of a European policy on standards also has a universal interest. IBM's leading position in the industry enables it to set standards for the world. Sometimes these may be good standards, sometimes they may not. Always, the effect is to put pressure on competitors to follow the IBM way and to make it difficult for customers to change to equipment or software using other standards.

Both users and the industry have an interest in the adoption of impartial standards which are the best and which allow all kinds of companies to develop new products confident that they will not be rendered obsolete by arbitrary changes in standard by one major firm, and which maximize the opportunities for users to combine together equipment from different manufacturers and transport software from one kind of equipment to another. Sometimes the best standards which are then adopted may be IBM standards, sometimes they may not. Such standards can only be effectively enforced by a combined policy of European public users and buyers. On this side of the Atlantic an excellent example of such a policy was provided by the U.S. Federal Government when it established Cobol as a standard, high-level language. This is an area in which I could imagine useful possibilities for collaboration between the Community and the United States.

To sum up:

Looking ahead, what kind of characteristics would I consider desirable for the future structure of the European and world computer industry? Needless to say, in an industry as dynamic as this, the free play of competition can and must produce unexpected results.

However, certain things should be said.

(1) Both in Europe and the world those who use the products of this key industry need to be served by a number of major competitive and profitable enterprises which have an overall systems capability. I would like to see European industry contribute vigorously to at least one of these enterprises.

(2) The great potential economies of scale in this industry have helped to engender a striking difference in profitability and overall strength between IBM, the industry leader, and the smaller companies in the business. This has been reflected in the steady process of concentration during the last few years.

In an ideal world I would like, in 10 years' time, to see other competitive enterprises in existence as strong and profitable as IBM and offering a comparable range of services.

(3) The rapid development of distributed computing systems is a hopeful feature of the present industrial structure. It means there ought to be growing scope for a wide range of enterprises of many nationalities producing minicomputers, peripherals and terminals, software and services, and communications equipment.

(4) However, to insure that the full benefits of this development accrue to the user, public policies need, through standards, unbundling policies, and other measures, to insure the maximum degree of transparency in the market so that users can buy optimal systems using the products of many manufacturers.

In all these matters Europe and the United States have common interests on which, I hope, one can build constructively in the future.

Senator HART. Thank you very much, Mr. Layton. I share your feeling that there is a community of interests here. One of the very first criticisms that I ran into several years ago, when I first introduced the Industrial Reorganization Act, was that it took an approach that seemed to seek to diminish the size of certain lines of American industry, at the very moment the EEC was encouraging the development of a counter giant.

The effort began in Europe to strengthen its several computer firms. Now, having run into that at the very start of this effort to develop legislation, let me ask you more specifically to describe what the EEC has done. One, do European companies get subsidies? Is there a preferential purchasing policy? And what other nontariff barriers does the community erect?

Mr. LAYTON. Thank you Mr. Chairman.

I'd like to just comment on one little phrase of yours: you said a "counter giant." It looks at the moment more like a "counter dwarf."

I think I would like to underline this point, that the help that has been given to the European industry, so far, has been an attempt to insure survival of something.

And before I say a word on your question about what support, what procurement, I think we should just recall the share of the market and the scale of the imbalance in the European computer industry.

Now, in terms of installations, at the end of 1972 IBM had about 60 percent. The largest single European company, ICL, a British company, had 7 percent; and the Unidata group had about 8 percent. So it was 15 percent of the European market for the four largest computer companies.

Another 20 percent was held in terms of installed installations by four other leading American companies. So what has been done so far is to keep something alive, but it has by no means become a giant, and we take the view, as to I think the governments which have supported these industries—and some of them are now combining together into one group, one rather small group in world terms—that their survival is one more ingredient of useful competition.

What is the help that has been given them, to help them survive? First of all, I have already mentioned subsidies, or rather help in research and development which is the form which financial help has taken.

And, frankly, the view taken in Europe is that the U.S. computer industry has had an immense stimulus from the major Federal Government programs in defense and space, not just from money but from demanding systems requirements. That's been a wholly valid and justifiable public stimulus which has had a very great fallout into the overall capability of the industry.

Senator HART. If I could interrupt you, better to understand you, are you saying because the Defense Department and the space program of this country require computer facilities, and the purchase is made of those facilities, that that is regarded in Europe as Government-supported R. & D.?

Mr. LAYTON. No, Government-supported R. & D., to be more specific for instance the ILLIAC, to take a recent, contemporary development, with advanced componentry is supported by Government funds in the United States.

And there have been many other examples of advanced technological developments supported by Government funds. The development of the component industry in the United States, which is an element within the development of computers, has been immensely stimulated by the space and defense programs.

And no one is quarreling about this. This is a historical fact. The research and development has been stimulated in significant measure, paid for by Federal Government funds.

I gave you that figure from the OECD report on the technological gap in the data processing in the electronic computer industry, which is an impartial document agreed by all the governments which showed in that particular year, in the mid-1960's, that spending on R. & D. in computers of Federal Government money in the United States, through defense and space, was about $300 million. And that is what I am referring to: the R. & D. development which capability has then been used, very naturally, in other fields.

Since this position has been created which has helped to generate the strength and capability of the American computer industry—of course it's not the only factor; business leadership, management, innovation, and commercial exploitation skills have played a major part, too—the defense and space contribution has also been significant.

Given this background, the European governments have felt that to enable some European industry to survive and develop they have had to also give some compensatory help in the R. & D. field.

And, frankly, they had seen it as a means of redressing the balance. In other words, we don't live in a pure, old-fashioned, 19th-century market economy, where innovation and development just happens by private people's investment and money; we live in a world where the public sector and its funds play a part in most advanced countries.

And the form in the United States has been through defense and space. In Europe there has been some money given directly to the R. & D. budgets of the computer companies.

And this amount in the current 5 years, 1971 to 1975, in Britain, France, and Germany, which are the three countries where this spending has been going on, has amounted, roughly, to $450 million. So, that's the first point. It is true, therefore, there is help given to the R. & D. budgets of these countries.

Now, the second question, a very important one, is what degree, if any, of preference or procurement help is given to help the European companies? And it is true that just as in the United States there is a Buy-American Act and a certain amount of support to Amreican industry in public buying, so this is true in some of the European Community countries? And particularly those which have had an indigenous industry they are seeking to support, such as Britain and France for instance.

Now, this preference, or encouragement, to the local national industry has not gone so far as excluding American companies.

Competitive products have been bought in many fields. In some countries there is no preference at all. But it has helped the local companies to enlarge their relative share of the public market in certain of the European countries.

Now, all this was, if you like, national policy in single, independent European states. The resolution of the Council of Ministers which I

referred to, of June 25, foresees the development of a policy in the European Community. It's not too easy to predict the future of the European Community, even if I could speak officially. I couldn't predict exactly what's going to happen, because the European Community is a continual process of negotiation between the member governments. So the implementation of this policy will be open to everyone and will require a growing consensus, but I could foresee certain characteristics that might be likely.

The resolution talks, for instance, about trying to make economies in the public expenditures side by joint applications work. There are many applications of data processing from air, sea, and rail traffic control to environmental monitoring, customs systems, where there is a common interest, and so there will be a common requirement. There may be a development in the Community of common requirements and developments.

Second, there is talk in the resolution of giving a Community orientation to standards policies, and also procurement policies. And you will certainly want to know what this means.

Now, here, as I said, I cannot exactly predict the future. But I can make some helpful remarks, I hope. First of all, the Rome Treaty says that all companies which manufacture in Europe are counted as European countries; and, therefore, have basically, ultimately, the right to have access to the different markets in the Community.

Second, the real-life situation in the Community is that adjustments, over a period of time, to an opening of the market are what normally takes place.

And I would imagine that the member governments will wish any adjustment to a more open-market situation within the Community to take place gradually. This has been a common experience.

Third, I would like to comment that in the past, in some member states, where there has been impartial evaluation of equipment, particularly hardware that has been bought, it has resulted in IBM's getting a smaller market share.

I think it's interesting to compare this with the experience in the U.S. Government procurement where the non-IBM companies, in some fields, have acquired a larger market share than in the private sector.

So one doesn't necessarily have to be a protectionist to pursue a policy which may lead to a better balance, competitively.

I would also add that all the European governments, whether they have an indigenous computer industry or not based in their countries, express a strong wish to have available to them more than one major supplier in the computer business. And I think they would wish their procurement policies to help to insure that. They do not wish to be at the mercy of a single supplier.

So that is another factor they will take into account. I'm sure they will take into account when and whether computer companies, be they American or European owned, are manufacturing in areas which are of regional importance.

So, in other words, any developing community procurement policy, or orientation of procurement policy, will weigh out a number of factors, of which the desire to have competition, the needs of regional development, will all play some part, side by side with the desire to buy the best equipment and to have in being a variety of competitors.

I can't give you a more definite answer because this policy doesn't exist yet in detail. But those are all elements which will contribute to it.

One final element, you may ask, "Well, what about imports from outside?" That is perhaps what people are most concerned with when they talk about nontariff barriers. And, here again, I can't speak in advance for what will come out of the worldwide trade negotiations, but speaking personally it must be clear to all the partners that in an industry like the computer industry there will be an interest on both sides of the Atlantic in removing barriers; the Buy-American Act as well as any European preferences or restrictions, which would obviously be considered together.

Senator HART. You mentioned a buy-American policy earlier in your comments. I have the impression that there is no prohibition against the purchase by our Government of a product manufactured outside of this country.

Mr. LAYTON. As I understand it, there is still in the defense field a basic 50-percent preference. It doesn't exclude foreign equipment, and in nondefense fields there is still also—I think the figure is 14 percent, or in that area, of the preferential increase that's used when applying purchase from abroad. But I am sure that other witnesses here can help. I am the least well-informed of the many witnesses you will hear to give you the details on this question.

Senator HART. I am sure it is a lot safer for the purchasing agent to make a decision to buy at home than abroad. I just don't know what the statutory limitation is.

Mr. Nash?

Mr. NASH. Mr. Layton, you indicated earlier that the four largest European companies in 1972 held about 15 percent of the computer-installed base in Europe. Can you give us the dimension or size of those companies, roughly, in terms of assets or revenues so we can see how large a company, or companies, we are dealing with?

Mr. LAYTON. Well, you are dealing with four different kinds of companies. Four different companies and four different kinds of companies.

ICL—International Computers Ltd.—which had 7 percent of the installed base and a market share roughly comparable at that time, is a computer company. It's not part of a conglomerate. There are large shareholders outside, but it is an independent computer company relying on the cash flow coming from the computer business.

And its order of turnover is in the range of $150 million. I can get you the exact figures.

Mr. NASH. Well, maybe it would be best to just supply them for the record.

Mr. LAYTON. Yes, I can give the detailed figures on that.

[The information referred to appears as exhibit 3 at the end of Mr. Layton's oral testimony.]

Mr. LAYTON. CII is also essentially a computer company, although it also has large shareholders, and its turnover is rather smaller. They are growing fast.

The other two companies, Siemens and Phillips, are different types of companies. They are computer businesses. They are, of course, a small part of very large conglomerate electrical companies. If you

like, the analogies are much more with GE and RCA. And the analogies between ICL and CII are much more with companies like CDC. ICL is very much a computer company with computer people in it.

Now, the Unidata group has been formed by a combination of the computer businesses of Phillips, CII and Siemens together: so that, despite the different natures of the parent they have found it able to create a joint enterprise.

Now, I believe that one may draw a rather limited moral from the different natures of these companies. We saw that GE and RCA, despite their size, were not able to compensate the disadvantages of the size of their computer operation by pouring in capital from other parts of the company.

And I think the same is strategically true for Phillips and Siemens, that the decisive thing will be the size and strength and effectiveness of the joint computer operation, which today is still relatively small; in fact Unidata is still something like half the size, or a little less than half the size, of the computer operations of leading U.S. companies like Honeywell and Univac, non-IBM companies.

Mr. NASH. From what you say I think it is clear as to the reasons for the European governments pushing for the formation of Unidata.

Let me ask you if you are able to prognosticate a bit for us as to your judgment as to what the emphasis would have been on forming Unidata if instead of having one company controlling 60 percent of the European market we had that share dispersed into multiplicities of smaller companies, even assuming that they were U.S. companies like CDC, Honeywell, Sperry, et cetera.

What would the pressures be under those circumstances?

Mr. LAYTON. I believe the pressures would be less. I tried, frankly, to describe two motivations of support for the European-based industry. To be frank, there are two.

One is the fear of the dominant firm and the other is the feeling that there should be some part of the industry which is controlled in Europe.

But, there's no doubt about it that the pressures from the factors of dominant firm have given an extra bite to this policy; and it is an interesting fact that this is the first sector of industry in which the Council of Ministers of the European Community has passed a conscious political resolution seeking such a policy. And this resolution specifically talks of the imbalance in the structure of the world computer industry in its preamble.

Therefore, I have little doubt that the strength of the European reaction would have been less if there were not this dominant position. And the opportunities for European companies to be viably in the business, without subsidy, would have been greater. I think that is, perhaps, the decisive point.

Mr. NASH. It would be helpful for the record if you could elaborate a little bit about how IBM conducts itself in Europe and, specifically, what you see the concerns and fears of the European governments to be.

Mr. LAYTON. Well, now, I will do my best to give a fair and balanced view of IBM in Europe. I've no doubt that they would like to say a lot themselves that perhaps they didn't yesterday. I'm sure the complete picture needs to be filled in by them and their competitors as well.

But I'll try and give a picture of how IBM seems, to some of us who have been concerned with the computer industry for some years.

First of all, IBM is clearly the leading company in the industry, with 60 percent of the installed capacity and an integrated, Europe-wide operation. That's to say, it has companies in most of the major European countries, specializing in the development and production of one or more products which are then sold throughout Europe by its Europe-wide sales and service operation.

And by this continental operation, it has achieved very important economies of scale which have not been achieved, in my judgment, though the evidence is very hard to come by, by any other companies.

So that's the first fact: It has achieved important economies of scale by the size of its grip on the market and by its policy of specialization and rationalization throughout Europe.

Now, those are in many ways positive points for IBM: that it's conducting a highly economical and efficient operation in the manufacturing field.

Why is there concern? Now, first of all, I mentioned earlier to you the paragraphs in the treaty, article 86 of the Rome Treaty, which outlaws abuse of a dominant position. And I think I should once more clarify my own position on this: I'm not speaking for the formal official policy; I'm speaking personally. And clearly, any cases of abuse to justify the bringing of a proceeding against IBM would have to be proved in detail, just as cases are being fought and have to be proved in detail here in the United States.

So what I will say to you is really an account of the concerns, the fears, the kind of risks which users and governments fear they might have to face through IBM's dominant position.

First of all, they have heard and read about many of the cases—the various cases that are going forward in the United States—being pursued by the U.S. Government, and the *Telex* case. And they are concerned because it would be the duty of the Commission to explore whether similar abuses—whether what indeed have been described as predatory acts—have been done in Europe as well as in the United States.

That is a first possible concern which would have to be proved in concrete form, yes or no. But it's a reason for concern and anxiety.

Secondly, I have already mentioned the problem of standards; but without any doubt, this does already present a major concern to users, to governments, to other people in the industry.

IBM inevitably sets world standards, and these are not necessarily those which have been agreed by the International Standards Organization; and if I may put it a little bluntly, even saintly behavior by a giant forces competitors to run behind.

This means that it is not enough to have thought up a useful and valuable innovation. It has to conform to the IBM standard.

I think the problem is the lack of predictability, the lack of transparency and foreknowledge of changes. This automatically gives a premium to the leading company which sets the standards, and makes difficulties for other companies which are having constantly to follow and adapt their products to fit the IBM standards. It's inherent in the situation, and it doesn't necessarily imply great wickedness on the part of IBM. But it is a problem, and a source of great concern.

Now, users, both public and private, are concerned to have a free choice of equipment. And without any doubt, there is concern lest, by being locked in to a certain kind of software like IBM software, it is not possible to shift to cheaper equipment except by paying a high price. So the cost of change is high, and this means that the customers who are really IBM's customers are to some extent imprisoned. And this reduces the transparency and openness of the market. Our preoccupation in the European Community is to have an open, competitive market.

There is also a concern that this difficulty of change, that this leadership in standards, may not necessarily mean that the most advanced technology can win out in the marketplace.

Finally, I think I would add a rather general and basic point. There is a fear, a concern, about control by a single, immense concentration of power, of economic power. This is also a concern.

Mr. NASH. Is that because it is an American firm?

Mr. LAYTON. No; it has nothing to do with it being an American company. I've made a distinction between the two. We are talking at the moment about one company.

If this were a European company, it would still present a problem. In fact, I think that's a good question. You put me the question: Supposing IBM were to become, by some magic, tomorrow, a European company. Would the problem be over? And the answer is "No."

Now, I don't say that it is easy to document or prove or remedy these concerns. But you asked me why they were there and what were the fears? And those are some of the fears which are very widely expressed.

Mr. NASH. What recourse, what alternatives, in your judgment, does the EEC have to take action to rectify the concerns you indicate?

Mr. LAYTON. So far, we have only been able to identify two possible recourses. One is the essentially modest effort we are making to keep in being certain European companies, and we certainly welcome the remaining in being of competive other American companies; that is one thing.

And the second is if there is concrete evidence of abuse of a dominant position, then it would fall on the Commission to bring a case against IBM. But the "if" is very important. The concrete, detailed evidence has to be brought together; and if these allegations turn out to be well substantiated, then there is this second possible recourse.

Mr. NASH. We had the privilege of meeting Willy Schleider several times. I am sure that if such evidence exists, he will uncover it. I will continue to read the report. As you know, the Justice Department is litigating, getting ready to go to trial, with respect to its antitrust suit against IBM, seeking diverstiture as a relief.

Would you react positively or negatively should the Department seek as part of its case to restructure the World Trade Corporation as well?

Mr. LAYTON. This is really music of the future, if I might translate a German phrase, and speaking personally, make the following remarks: If we in the Community, if the Commission, were to find there were substantiel evidences of abuse of a dominant position, if such a situation were to arise, then presumably the Community would also face the question of whether there would need to be any form of relief.

There must be some remedy if there were a case successfully brought. And I think that all we have said today has shown that there is a common problem. I think this is the most fundamental throught which I'd like to leave you. This is very much a common problem which we face on both sides of the Atlantic.

If the time comes when the Department of Justice is practically—and the courts in the United States are practically—considering measures of relief which have a major impact on Europe, I would have thought that it would be very appropriate that there should be close consultation with the European Community about the form that this should take, recognizing that, if you like, we have a common interest in solving the problem.

That is the first point. Now, the second point is my personal view of the idea of divesting, breaking up IBM into a number of companies. I can only comment that the European structure of IBM might present more problems than the American structure, if such a hypothesis were being considered. IBM in Europe, to the best of my knowledge, has one production center, or at any rate for some key products, only producing particular, major products; whereas, in the United States, in several of its major products, there is more than one production center which makes it easier and more logical to make out of such a company a number of entities, each enjoying the optimal economies of scale.

I would leave one thought: IBM's strength is not only in its production capabilities but also in the strength of its lease operation; and one idea which has been suggested in Europe—not in fact by me, but I quote it to you because I find it interesting—is the concept that IBM's leasing operation and its basic—its banking business—should be separated off from the production and development operation and made a leasing bank for the disposal of the entire computer industry. Now I offer you that thought quoted, from another European, not as a proposed action but as another thought to add to the many ideas which, I think, we are freely debating today.

Mr. Nash. We have heard that IBM contributes significantly and in a positive manner to the U.S. balance of payments and balance of trade. Similarly, I might add, we have also heard that IBM contributes significantly and positively to the European balance of payments and balance of trade. I am not an economist, but that concept does perplex me. I was wondering if you have any information that you might be able to supply now or when you return to Brussels with respect to IBM's contribution in the balance of payments, balance of trade of Europe as a whole, or even individual countries in Europe?

Mr. Layton. That is the kind of question which I would like to hear IBM answer. I mean, I am genuinely interested in the answer. I think it is a very interesting and important question. I think it is much better to get the figures from them because I am only a second-hand individual. But, I have been led to believe that IBM, in several major European countries, pursues a policy of trying to have a balance in its payments; that is to say, the imports and exports roughly balance out in the overall national operation. And this may mean that it has a net trade deficit in relation to the United States;

that is to say, it imports more from the United States because it imports larger computers and certain kinds of special equipment from the United States. But that in the European operations of IBM it exports substantially to other parts of the world. That I think is a rather likely explanation on which I am sure their own views would be of interest.

Mr. NASH. I was wondering if there is any truth to the rumor that we have heard, and which I know you have heard as well, respecting the formation of a European cartel to compete against IBM?

Mr. LAYTON. Well, first of all, if any such cartel came into existence the Commission would be under obligation and would take it to court. It is certainly not part of the Community's policy, to the best of my knowledge, to foster such a cartel. Just as we have the obligation to take to court a company which abuses dominant position, so we have the obligation to take to court cartels. In fact, if you look at the experience of applying the Community's competition policy over the last 10 years, the policy for banning and imposing heavy fines on cartels and restrictive practices is the part of the treaty which has been enforced much more effectively because it is spelled out in much more detail in article 85. Just to recall one of the larger cases last year, or 18 months ago, the Commission imposed very heavy fines on the sugar manufacturers for having a cartel. So we would be delighted to have detailed information about any such arrangement in order to take action.

Mr. NASH. Thank you very much, Mr. Layton. No further questions, Mr. Chairman.

Senator HART. Mr. Chumbris?

Mr. CHUMBRIS. Thank you, Mr. Chairman, I have just one observation. It relates to the share of the World market. I am reading from Mr. Biddle's statement wherein, I believe there is a quote from findings of facts and conclusions of law of Judge Larson in the *Honeywell* v. *Sperry-Rand* case. He pointed out in the terms of total revenues stated in dollars, and market shares in percent of revenues of the entire industry. SR, which I believe is Sperry-Rand, and IBM have the following shares of EDP market—that would be electronic data processing market—in 1956: World market, IBM—42.9 percent; Sperry-Rand—51.2 percent. In the domestic market, IBM had 47.5 percent and Sperry-Rand had 45.5 percent. Then, if we go to the back of page 15, there is a chart which shows that in 1973 for general purpose EDP systems, December 31, 1973, IBM had 63.8 percent in the United States: and Univac, which was Sperry-Rand, I assume, has 8.5 percent. In the World market, IBM had 64.4 percent and Univac had 8.1 percent. So from 1956 to 1973 there was a tremendous change between the percentage of sales by IBM and by Univac. I believe that the testimony that has been given us thus far indicated why IBM took such a jump over Univac. Univac concentrated on the scientific approach in computers and IBM went into the industrial or commercial aspect. And, because of that, we have this tremendous gain in IBM over Univac. If you will look at the chart I just referred to, even Honeywell has gone above Univac.

I think the facts should be determined as far as this legislative hearing is concerned and we will let the court case in October be taken care of by the parties to that case. We will just confine ourselves to this bill and look at it from our own legislative purpose. I think, we ought to get the facts, and some of them came up yesterday by the witnesses from Data Corp. and other witnesses who testified yesterday will testify in the next few days as to what it was that shot IBM from below Sperry-Rand in 1956—Sperry-Rand had 51.2 and IBM had 42.9—to a difference where Sperry-Rand has only 8 percent while IBM has 63.8 percent.

I think that is the type testimony we ought to be developing for the record. Is it efficiency; is it economies of scale; is it the product; is it also the service that they give, as indicated further by Mr. Biddle, in his paper on page 26, I believe, when he was conducting an interview on behalf of Bendix, and these were the responses he received.

"IBM equipment is second best in terms of price and performance."

Two, "IBM's service and support is second to none."

Three, "IBM already has software I need."

Four, "My management thinks IBM is the better choice."

And besides, he goes on, "If I buy a non-IBM system, and something goes wrong, I'll be in trouble. If I buy IBM and something goes wrong it is an act of God." He doesn't explain what the act of God means, but I guess we could get an explanation of that also. I think that is the situation. It is exactly the same in the United States as it is worldwide.

Do you visualize with the combinations that you just talked about in Europe to come out with a 7720, that you might be able to do in Europe what IBM did to Univac. That is a possibility. Is this so?

Mr. LAYTON. It is not excluded, but it is going to be jolly difficult. I mean because there is now an enormous acquired marketplace. I think it's—one shouldn't forget—just another point concerning these figures. The total market in 1956, which you are looking at, was, of course, much smaller than the market you are looking at now. Even so, it is true that the headstart at that time, I think, came partly from the punchcard customer market which IBM had. But, today, the fact that IBM has 60 percent of the installed capacity of Europe is in sheer quantity an enormous inertial problem to wean IBM customers away. And, in fact, the other computer companies tend to be fighting for the new customers, and not so much for the replacement market. Of course with the growth of the market this is still a possibility, and you can still expect and hope to enlarge your market share. But it is extremely difficult because of this enormous customer base and of the cost of change. I think that this is one of the built-in structural problems that we now have.

Now, we can go back and ask: How did IBM get there? In what measure are they excellent? In what measure are they pursuing practices which are accused of being improper? I, without doubt, believe that though their acquired market position is a great source of strength it is also true that they do have major economies of scale in all these

fields—and, justifiable economies of scale in production and R. & D. And that this helps to maintain their very high profitability. Therefore, their position is not maintained by what can be described as illegitimate means. Their very size is a very important factor which makes it very difficult for competitors to break in and enlarge their market position. There is quite a lot of evidence that it is still possible by innovation, by selecting particular areas of the market, to getting over a certain threshold of size. Below a certain size it is not possible to break in. But above a certain size, and we hope to achieve that in Europe, we believe that we can gradually shift the balance. In the last 2 or 3 years the European share of the market has been improving slightly, compared to IBM's. And, incidentally, Univac's market share has been slightly improving lately after falling a great deal. Therefore, it is not impossible to shift the balance, but it is extremely difficult.

Mr. CHUMBRIS. As I stated earlier as we go into these hearings we will have to develop a record. It is pretty difficult, when you make a jump from 1956 to 1973, to know the step-by-step reasons for the change? But I think as we go through our hearings we should take it almost on a year-by-year basis. For instance, when I was a young man I remember the prestige car, at least in Washington, D.C., was the Packard. That was the ultimate. We don't even have Packard on the market today. Today, it is take your choice whether it is the Continental or Chrysler or the Cadillac, the top car, as far as domestic U.S. cars are concerned; or the Rolls Royce and the other foreign cars coming into the market.

Another thing, I was born in Washington, and I remember when the Washington Post was not a successful newspaper; other newspapers were more successful. Look at the Washington Post today. A change in management and improvement of facilities at the Washington Post put it on the top. Two other papers that were giving it a rough time back in the 1930's and 1940's had to combine to meet the competition of the Post in the city of Washington. That is the basic facts of the industry. I think we have to get it on the record. I think the record ought to show what happened in 1956, 1957, 1958, 1959, and 1960 up to now that developed the industry as it did.

That is all I have.

Mr. NASH. Mr. O'Leary picked up an important point and Mr. Chumbris went into it. If I might have a moment. You mentioned, Mr. Layton, that IBM's market share in Europe is apparently due to significant economies of scale. I think it is important for the record to see if we can't break down what economies of scale are referred to in this instance. I can think of a variety of possible definitions. One might be a large number of units sold by IBM to spread manufacturing costs over a large base to bring down the cost per unit, including the R. & D. costs per unit.

Another concept might be that their installed base permits the spreading of such a large quantity of marketing and support personnel which, in turn, contributes to the retention of the market share.

If you could elaborate on your concept, I think it would be helpful.

Mr. LAYTON. I think it includes all these elements. It certainly includes the size of the production run, writing off as a cost of research and development of a range of computers or equipment. Despite the fact that they have an immense R. & D. effort, the proportions of turnover spent on R. & D. is smaller than in most other companies, including European companies, because of the least size of turnover.

Certainly there are also production economies of scale because of the lengths of the production runs. And, also, there are economies of scale in the production of software applications packages, for instance, which are sold to a variety of users. There is also a threshold you have to cross for being able to maintain effective sales and service facilities in a region. And, if you have a very dense market coverage then you can maintain a dense pattern of sales and service facilities. They are able to do this in Europe on a more lavish scale than any other companies—and that is a further economy of scale.

In other words, it includes all these elements. All of which means that in the computer business there is evidence that suggests that any major leap in market share can bring a significant advance in profitability.

Mr. NASH. Does that imply that the minimal scale economies are at the 60 percent scale of market or just that it has to be above the 7 and 8 percent?

Mr. LAYTON. I think it is dangerous to speak of one threshold. There are many different kinds of thresholds.

In a study that was done for us—one estimate was suggested for instance for a particular national market. There was what you might call a marketing threshold—that you had to have at least 7 or 8 percent of, say, the French market, or the British market, in order to be able to maintain sales and service facilities that are the minimal necessary for being a viable competitor. That is just one kind of threshold.

Then, if you ask the question, "Do I wish to number amongst my customers multinational companies?" you will note that you will have to cross the threshold in many markets. And, immediately you have found a wider marketing threshold worldwide. We can say the same of production of particular kinds of products—components, and subassemblies—that there are different thresholds of scale which you would have to cross. Therefore, it is a very complex subject, there is no doubt about it. I think it is dangerous to say that 10 percent of the World market is the threshold; if you are smaller you are unprofitable, and if you are larger you are profitable. It might be smaller, it might be larger; it depends on all kinds of aspects of your management skills and company strategy. But there is no doubt that between having 8 percent of the market and 60 percent there are a great many advantages of scale which the company with 60 percent manages to achieve.

Mr. NASH. Thank you very much.

Senator HART. Again, Mr. Layton, we are very grateful that you could come.

Mr. LAYTON. Thank you, sir.

Senator HART. I must suggest a recess before we hear our concluding witness, because of obligations I have beginning at 1 o'clock. In fairness to the committee and in fairness to our witness, I suggest a recess until 2 p.m.

[Whereupon, at 12:40 p.m., the subcommittee recessed, to reconvene at 2 p.m. this same day.]

MATERIAL RELATING TO THE TESTIMONY OF CHRISTOPHER LAYTON

Exhibit 1.—*Council of Ministers of European Communities resolution re common industrial policy*

BRUSSELS, *5 July 1974.*

EUROPEAN COMMUNITIES

THE COUNCIL

RESOLUTION OF THE COUNCIL OF———————— ON A COMMUNITY POLICY ON DATA PROCESSING

The Council of the European Communities,

Aware of the importance of data processing for all aspects of modern society and hence for the Community and its economic and technological position in the world;

Aware that the structure of the data processing industry in the world is unbalanced and that the applications of data processing within the Community are not yet satisfactory;

Convinced that this situation should lead the Community to contribute to the design, development and manufacture of the various components of data processing systems through competitive European-based companies existing alongside the important companies controlled from outside the Community; convinced that both can prosper in an expanding market;

Aware that effective competition is desirable and that the present situation makes appropriate measures necessary to encourage European-based companies to become more competitive;

Convinced that a more efficient and economical use of resources can be obtained through collaboration or, in suitable fields, through joint action on standards and applications, and through collaboration on public procurement policy;

Aware that associations between producers' can help to make European-based companies competitive,

1. Intends to give a Community orientation to policies for encouraging and promoting data processing, and welcomes the Commission's intention to submit in 1974, after appropriate consultations, priority proposals concerning:

(*a*) A limited number of joint projects of European interest in the field of data-processing applications;

(*b*) Collaboration on standards and applications and in public procurement policy;

(*c*) The promotion of industrial development projects on areas of common interest involving trans-national co-operation;

2. Will take a decision on these Proposals no later than six months after the European Parliament has given its opinion;

3. Consider that it is desirable to prepare, in the medium term, a systematic Community programme to promote research, industrial development and applications of data processing. This programme would provide for the co-ordination of national promotion and Community financing in appropriate fields of joint European interest, with the central aim of ensuring that by the early 1980's there is a fully viable and competitive European-based industry in all the fields concerned;

4. Invites the Commission:

To accompany its proposals with details of their financial implications, including, where appropriate, the cost to the Communities' Budget for each of the next five years;

To submit annually, by 1 July at the latest, in the light of all decisions taken by the Council subsequent to this Resolution, a report to the European Parliament and the Council on all expenditure incurred as a result of such decisions;

To submit to the Council, by the end of 1975, a report on developments to the data processing sector in the Community in relation to the world situation.

Exhibit 2.—*Council of Ministers of European Communities document re background information pertaining to resolution re common industrial policy*

COMMISSION OF THE EUROPEAN COMMUNITIES

SEC(73) 4300 final

BRUSSELS, *21 November 1973.*

COMMUNITY POLICY ON DATA PROCESSING

(Communication of the Commission to the Council)

CONTENTS

DOCUMENT I

INTRODUCTION

Communication of the Commission to the Council

A Community Policy for Data Processing

1. The Summit Conference called for the progressive and effective opening of public sector purchases and for the establishment, in the advanced technology industries, of competitive companies at European level. In few industries are these objectives more relevant than in data-processing. Now the third largest world industry after chemicals and cars, growing at some 15% per year in the U.S.A. and 20% per year in Europe (see Annex point 1 for details), it penetrates increasingly virtually every walk of life, transforming management and administration, education and science. The very structure of society may be determined in the future by the way it uses information systems. As labour-intensive industries move towards developing countries, Europe needs to develop, rapidly, industries requiring concentrated skills of a high level; of these data-processing is a classic case.

2. Yet though European minds conceived many of the basic concepts of the industry and Europe still has a powerful intellectual and technical potential in this field, it has yet to transform it into effective industrial strength. Over 90% of the computers installed in Europe are based on American technology. Some 60% of the world of European market is held by a single dominant firm based out-

side Europe (IBM). Though this company has made and continues to make a massive contribution to the commercial application of data processing, its position enables it to determine the pattern of prices and standards, to dictate the pace of commercial innovation and the pattern of the market. In no other key industry is a single firm so dominant in both Europe and the world. The Commission, in accordance with its obligations under Article 86 of the Treaty establishing the European Economic Community, will be vigilant to ensure that there is no abuse of such a dominant position.

3. The most effective guarantee of good behaviour is, however, the existence of strong and viable competitors. Competition is at present provided by other international companies based outside Europe and operating within it (see Annex point 2), but there is no certainty that they will remain in the competitive race and the social, political and economic importance of this industry are such that Europe cannot afford to opt out altogether.

4. A flourishing European data processing industry must include strong European based companies in both hardware and software side by side with the important companies controlled from outside Europe. In an expanding market there is room for both.

5. The leading world position of the American companies owes much to commercial skill and good management, but much, too, to the fact that the United States first provided a rich Continental market for the commercial applications of data processing, while in the last twenty years the Federal Government has provided a huge, sophisticated market for the U.S. industry and stimulated its growth by development contracts (See Annex point 3).

Any support needed in the next few years by the infant industry in Europe must not be seen as a form of permanent protection, but as a mean of redressing this imbalance by providing comparable opportunities to the European-based companies so that they too can acquire continental, indeed world dimensions, and stand competitively on their own feet.

A Community policy for data processing must include two main types of actions: to develop the capacity of the European-based industry and to promote the effective use of data-processing. These main thrusts of activity need to be complemented by a limited number of background measures. This communication will examine the problems in this order concluding with proposals for Community action.

A. Building a Strong European-Based Industry

CENTRAL PROCESSORS

6. At the strategic heart of computing systems is the central brain or processor (IBM's 370 series, ICL's new range, Unidata's new X series from CII, Philips and Siemens for instance). Europe's most evident industrial problem in computers is to develop a viable structure capable of competing with the dominant producer in the development, production and marketing of such a range.

7. In pursuit of this objective, at least three Governments (the British, French and German) have, in the past ten years, supported national computer companies, by means of financial support for computer development and preferential purchasing policies, details of which are given in the Annex, Point 3. The share of world markets of the four leading European computer companies (ICL, CII, Siemens and Philips) together is, however, approximately 6%, or roughly equal to the smallest of the remaining American competitors with the world leader. Both the losses made by certain European companies in the past and much evidence (See Annex point 4), suggest that separately, European-based firms will have great difficutly in attaining the minimum necessary scale to be economically viable on their own without permanent Government subsidy. The breakneck speed of growth in the market (some 20% per year) means that companies have to work hard to maintain even their existing market shares. A regrouping of the industry which respects the rules of competition under the Treaty is the only route to a major jump in relative size.

8. To be fully successful and competitive, a computer company should penetrate and have access to the major advanced markets of the United States and Japan. Collaborative agreements with non-dominant companies outside Europe offer one mean of acquiring this, and of tapping new technology and capital resources. But such partnerships can only bring their full benefits to Europe if they are based on a real equilibrium between the partners and not on an open

or disguised absorption of the European firm. A regrouping of the major European based firms must be seen as a key objective, making it easier not harder to find balanced relationships with firms outside.

9. It is for the companies concerned to seek out and negotiate with compatible industrial partners and subject always to a more thorough examination of the terms of the agreement, the Commission welcomes the formation of Unidata (by Siemens, CII and Philips) and the discussions going on with a view to further regrouping. Governments and the Community also have an important part to play by ensuring that procurement policy does not obstruct such moves and by pooling the financial resources with which they support the industry. It must be a legitimate concern of the Community and of Member States to rationalize and control public financial support for the data-processing industry in favour of the strongest possible industrial groupings.

10. Even if all the major European based companies grouped into a single entity, there would be no danger of monopoly or market domination given the incomparably greater size and strength of IBM. Such a combination is however unlikely in the immediate future, given the existing plans of the key companies: in the next three years the two major groups of companies may continue to coexist competing with each other in the marketing of separate series of computers.

11. In this situation, Community policy for the support of the industry can usefully be seen in two phases: in the short run, at least a limited collaboration, falling short of a full merger or combination, should be encouraged, both to achieve ends useful in themselves and to prepare the way for a further industrial combination later. Steps by the industry toward such a combination would facilitate the development, in a subsequent phase, of a more coherent and complete Community programme for the support of the data processing industry and its applications. Success in the second phase will largely depend on the effectiveness of collaboration in the first. Here a look at the other sectors of the industry—peripherals, electronic components and software—is necessary, for they too are essential to a strong industry.

PERIPHERALS

12. What has been loosely called "Peripheral equipment" comprises more than half the value of the hardware in new systems, and this share is growing, for computing systems increasingly involve an ever-widening range of terminals for transmitting and receiving information linked by networks to a central brain or brains, as well as a number of functional units (eg. memories, storage capacity, which are essential to, but detached from, the central processor). In the production of terminal peripherals and small computers, a number of specialised European firms have already proved successful. Some of these are small; some, like Olivetti, the largest European firm in this field, or Nixdorf, are comparatively large. Yet the "near-in" peripherals which form an essential part of all systems (disc-units tape decks etc.) are dominated by external producers and the overall picture is of a growing payments deficit and technological dependence in a key sector of the industry.

13. In terminal equipment, there are good commercial opportunities for a variety of European companies to enlarge their market share, and the most appropriate general form of public support at Community level for innovation appears to be the proposed Community Contracts for Industrial Development.[1] At the same time, if the European based manufacturers of central processors are to become an effective force, they may need to pool research, production and marketing capabilities for certain "near-in peripherals". Further examination at Community level is needed to see whether a specific limited programme of joint support for such development is needed in the form of "programme-oriented" development contracts.[2]

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[1] The Commission's current proposal on Community Contracts for Industrial Development [Doc. COM (72)710 final July 1972] is designed to support collaborative innovations of small to medium/size proposed by companies from any sector of industry.

[2] A different form of development contracts which may be called "programme-oriented development contracts" will be needed to support collaborative developments in the framework of specific sector programmes such as data processing. In such cases the Council, on the basis of proposals from the Commission would decide the objectives of a programme and allocate the appropriate funds.

ELECTRONIC COMPONENTS

14. Components form a third major element in the computer industry; this too grows in relative importance as the manufacturers learn to group hundreds of electronic circuits upon a tiny chip (see Annex point 5). Here the first need of the computer manufacturer is to have access to the latest technology at the lowest possible price. In part this need may be met by purchasing from outside companies, including companies based outside Europe. Some internal capability is however needed, both to make use of the latest component technology in system design, and as a guarantee that companies have access to the most advanced technology.

15. The overall problems of Europe's semiconductor industry, now entering the crucial phase of developing Large Scale Integration, will be discussed in a separate paper from the Commission. More special to the computer industry is the need to participate in the latest memory technologies (LSI, Bubble memories, holography and so on) any of which may prove later to have great industrial importance. These fields require an important effort of research and development, if the European based computer industry is not to run the risk of being left behind by radical new developments in the latter years of this decade. Here again a joint development effort involving the main computer companies would be essential and could be started now, using programme-oriented development contracts.

SOFTWARE BUREAUS AND CONSULTANCY

16. Buying the "Software" the programmes by which the information and needs of the outside world are translated into computer language—costs as much to the user, in most computer systems, as the hardware; and a strong industry is equally important for Europe (for details, see Annex point 6).

17. The development of the software industry has been led from the United States because of the strength of the American hardware industry and because the market for new applications is both larger and tends to develop there first. But because size of firm and investments are less important, the European industry is less at a disadvantage than in hardware and in those fields where European firms are active and well managed they can provide programmes and services competitive with those in the United States.

18. Certain weaknesses, however, might be usefully redressed by Community policies. Despite the formal "unbundling" introduced by IBM, which is far the largest software company, a great many user software programmes are in fact tied to particular types of hardware, or adapted, at a cost, from programmes designed for them. There is a need to develop a real "market" in user software in which applications programme packages are easily transferable from one type of machine to another. There will be an incentive to develop such transferable packages if public users jointly commit themselves to use them. There is also a case for using programme-oriented Community development contracts to support the development of "Bridgeware" programmes which make it possible to transfer existing applications from one machine to another. Further study is also needed to define means of protecting property rights of software products.

19. There is also a need to stimulate European capabilities, particularly in the public sector, by joint applications development programmes, which will place the European producers well for serving future public needs. Such programmes, if carried out by consortia or associations of European software and if necessary hardware companies, would act as a spur for the regrouping of an industry parts of which are too fragmented. The great defence and military projects which have been an immense stimulus to the American industry, need a realistic European equivalent designed to serve civilian needs. Here the needs of the industry rejoin those of the user. It is a theme to which we shall return in Section B below.

B. APPLICATIONS: SERVING THE NEEDS OF THE USER

20. No less important than building a strong industry is a second Community objective: to promote the effective application of data processing to the needs of the European user, in particular those of the public user and those which have an international or European character. There is much ground to make up, for in all too many organisations the use of computers is in its infancy.

OPENING PUBLIC PURCHASES AND COORDINATING PUBLIC PROCUREMENT POLICY

21. Public users of information systems have an interest, not merely in purchasing from the cheapest and most efficient supplier of systems, but in pooling their requirements, sharing in the solution of their common problems and thereby reducing costs and achieving more efficient answers.

22. The American industry has benefited greatly from the immense and sophisticated demands of the U.S. federal Government (see Annex point 3). State and city Governments and universities also have a number of cooperative arrangements for developing and purchasing systems together and thus saving public funds.

23. The power of procurement is already used today in several member states as a mean of promoting a national industry. That weapon, used nationally, not only infringes the Treaty but may increase costs to users and inhibits the European industry from working on a Continental scale.

24. In response to the ned for the progressive and effective opening of public sector purchasing, expressed at the Paris Summit, the Commission has already proposed a series of legal measures concerned with the coordination of tendering procedures in these markets.[3]

As a complement to these measures, the time has come to move on from national procurement policies to a close collaboration at Community level in procurement. This must be designed to support rationalisation and standardisation, to achieve greater economies for the user, through joint purchasing and development and the construction of common networks or services. It must also be designed to redress the competitive balance by providing opportunities to European-based industry. A systematic joint analysis of future requirements should make it possible to identify well in advance areas where users can usefully collaborate on applications and benefit from joint procurement.[4]

COLLABORATION ON APPLICATIONS

25. European Governments are devoting growing resources to computer applications (see Annex point 3). How can they best collaborate to pool and save scarce public funds, providing a stimulus to the European industry at the same time? Collaboration on three links could bring benefits.

a. *Common international projects*

26. Certain types of public application have an inherently international character. Environmental monitoring, meteorology, air, sea and land traffic control, customs and trade statistics, international technological information systems are examples. For such applications, international development and management are becoming not merely desirable, but essential. The Commission believes that the best way to fulfill a real public need and stimulate the technological capability of the industry soon is to plan and implement a small number of such projects on a common basis now. It has commissioned the first part of a study designed to help identify priority projects of this nature. It asks the Council to support such projects and will make proposals during 1974 with a view to decision by the Council before the end of the year.

b. *National needs common to several Member-States*

27. Such inherently international projects are not the only applications where benefits could flow from pooled resources. Many national or local public applications are common to different member states and savings could flow from collaboration or even joint development and procurement. Central Government administration, social security systems, health and hospital systems, education are examples.

Two meetings of the data processing subcommittee of the PREST group have already usefully helped the Commission to identify areas where collaboration or joint action would be useful; a continuous further process of coordination and confrontation will be necessary in the future to expose areas for cooperation or common development.

c. *Coordination*

28. In certain fields, coordination ought to be started now:

[3] See document on industrial and technological policy SEC (73) 1090.
[4] See document COM/73/459.

DATA BANKS

29. Large banks of data are now being established for a widening range of public and private users (for details see Annex point 8). A growing proportion of these banks in both the public and private sector will have an international character (banking, technological information systems, health, or police records), while in other cases (local Government, taxation, censuses), the difficult problems of managing the information are being tackled in parallel by many public authorities throughout Europe. Economies and greater efficiency will result if public users can jointly develop new methods of programming and managing this information (Data Base Management Systems), standardise the many features which are necessary to facilitate communication between them, coordinate the planning of their introduction, and identify technical problems where studies and development work might benefit from Community support.

DATA COMMUNICATIONS

30. The problems of data-communication, which may match the volume of voice telephone traffic in Europe within ten years (See Annex point 9), are increasingly a Community concern. The Commission is preparing wider proposals on telecommunications policy, but these will take some time to implement and in the meantime it is important that new data-communication networks develop as European systems and do not engender new technical divergences harmful to the user. The COST project 11, though a useful pilot research scheme, does not deal with the practical problem of the systems that are actually being installed. A procedure for the joint planning and management of data networks is needed.

HEALTH AND MEDICINE

31. A further area in which coordination can usefully start now is the field of health and medicine, an area of public spending growing in all member states.

INDUSTRIAL APPLICATIONS

32. Outside the public sector a more effective application of data processing to a range of industries important for Community policy (shipbuilding, aircraft, textiles) could raise productivity and enhance the capability of the European computer industry. As in the public sector, judicious development contracts for applications technology could be a means.

C. Complementary Measures

33. To provide a favourable environment for the twin policies of building a strong European industry and supporting the more effective application of computer systems certain additional measures are needed:

STANDARDIZATION

34. For both the user and the computer industry the development and effective application of common standards in hardware and software is an urgent priority. At present users are often tied to a particular company by the language and form of the programmes they use. If a real exchange of methods and a genuine market in software which could liberate the user is to develop, users, industry and standardisation organisations need to agree on and put into use common high level languages, for example for real time applications.

35. The manufacturers of peripherals also need standard interfaces which will make it easy to plug independent peripherals into larger systems. Standards are talked about in many international fora. The main need at Community level is to put a few key agreed standards into practice through coordinated procurement.

SUPPORT FOR LEASING

36. In addition to the need for support for development, the European based hardware industry faces severe problems in financing the leasing of computers. Small companies lack the immense inward cash-flow enjoyed by companies with a large existing customer base. Moreover, a company attacking a market held by an established firm, with a new range of computers, may run higher commercial risks and find it difficult to lease on terms equivalent to the market leaders.

Detailed proposals may be made by the Commission after discussion with interested parties. One possible form for support might be a European leasing company to back the industry.

EDUCATION AND BASIC RESEARCH

37. Neither a strong industry nor effective application of the computer sciences by users can be achieved without a continuing basic research effort and a strong educational effort designed, in particular, to raise standards, end the shortage of highly qualified people and promote mobility (see Annex point 10). There is also a need to ensure that education in computer sciences is not tied to particular companies. Consultations have already shown that to meet these needs the existing high level courses run by the PREST group on Education in Computer Sciences need to be extended; The social Fund[5] could also be used to finance training or reconversion of manpower in certain sectors. Further initiatives may also be needed to support collaboration in computing theory (where a European association already exists) and to establish a European Software Engineering Institute in the form of an association of national institutions developing, in particular, basic software.

STRUCTURE OF EMPLOYMENT

38. The expected evolution of the sector in the next few years due to growth, industrial change and alterations in requirements for skilled manpower will inevitably bring appreciable shifts in the structure of employment. The Commission intends to follow this evolution closely, bearing in mind the necessities of regional policy and with a view to ensuring that social considerations have their proper weight in a Community programme for the industry.

PROTECTING THE CITIZENS

39. The creation of data banks joined increasingly by international links will oblige the Community to establish common measures for protection of the citizen. When police, and tax, and medical records, and the files of hire purchase companies concerning individuals are held in data banks, the rules of access to this information become vital. This is a matter on which a wide debate is needed in the Community.[6] In view of its basic constitutional importance, the Commission believes that public "hearings" on the matter are desirable. It would be better for the community to seek a genuine political consensus on this matter now with a view to establishing common ground rules, than to be obliged to harmonise conflicting national legislation later on.

D. COMMUNITY ACTION

40. In the light of all these needs, the Commission submits the attached draft resolution to the Council. It seeks to do three things—to lay down the broad direction of a data processing policy for the Community, to provide a impetus for coordination of national policies in certain fields, and to pick out selected priority areas for common action.

41. The procedure proposed to give a community orientation to policies for encouraging and promoting data-processing, in particular by collaborating in procurement policies, standards and applications has not so far been mentioned in this report. The range of subjects on which specialised groups may be needed and their composition are so varied, that it seems appropriate to handle this matter pragmatically, bringing together the key national officials responsible for overall policy, or those responsible for procurement, or those responsible for certain types of application, as and where appropriate.

42. The priority for common action would be to undertake in common a small number of major applications development projects of an international character. The Commission will make detailed proposals on these during 1974 with a view to decision by the end of the year. Such projects, while serving identifiable public needs, will also provide a stimulus for collaborative effort by the European industry without being dependent on any particular industrial structures.

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[5] See document 71/66/CEE.
[6] See document COM(73)1250.

43. The draft resolution also asks the Council to consider (though not at present to commit themselves to) possible proposals from the Commission for common support for selective collaborative industrial developments. In the Commission's view these are likely to be initially in key areas of electronic components and peripherals, or software.

Here a word of explanation is needed. This report has shown that the crucial strategic area in which Eurpoe should pool resources if its indigenous industry is to be competitive is that of central processors, but it is also clear that with two major indigenous groups in existence this is not yet completely possible and that in these circumstances common funds are not appropriate for the support of such R & D. There are however certain areas of electronic components and key functional subassemblies such as memories ("near-in peripherals") where common development now may be considered strategically vital and possible and may even include the two major computer groups which are competing together in other fields. Certain areas of Software development may also be tackled at once. Further consultations and technical examination are needed before such proposals are made. Common finance may be appropriate in such cases if a common industrial organisation such as a joint subsidiary is set up to do the job.

44. As far as wider support for the R & D of the companies is concerned, the Commission has accepted in the course of examinations under article 92 of the Treaty that under present circumstances existing aids may continue to be given on a national basis. An effort must however be made to move on from the limited collaboration that is possible in the immediate future to a systematic programme for the development of European data processing which would provide a framework for future financial support. Such a programme would cover not only central processors, but the development of software, electronic components peripherals and applications. In conjunction with Community regional policy it should also ensure a reasonable distribution of this growth industry throughout the Community. In this further phase, there is a case for introducing a larger element of common finance to support the overall programme. Financial support for the European based industry, however, should not be regarded as permanent, but as temporary help designed to achieve the central objective of a viable European industry capable, by the early 1980s of standing on its own feet.

45. The draft resolution clearly does not cover all the needs raised in the Commission's communication (including for instance leasing, education and research). In such matters, further propsals will be made when necessary by the Commission, against the background of the growing collaboration which the resolution is designed to initiate by May 1974. The communication moreover is itself designed to provide no more than the essential starting point for an evolving Community policy. The Commission proposes to review progress in a report on the state of data processing in the Community to be completed before the end of 1975.

DOCUMENT II

Draft Council Resolution on a Community Policy for Data-Processing

The Council of the European Communities

Conscious of the importance of data-processing to the development of the Community and its position in the world;

Convinced that because of this importance Europe must contribute by its own efforts to the design development and manufacture of data-processing systems through strong European based companies existing side by side with important companies controlled from outside Europe both of which can prosper in an expanding market,

Aware that the unbalanced competitive situation in the world computer industry makes necessary special measures to help european-based industry to become competitive on a lasting basis,

Believing that both a stronger industry and a more efficient and economical use of resources can be obtained through collaboration or joint action on procurement, standards and applications,

Acknowledging the necessity to strengthen the European based industry by associations between suppliers, stressing the efforts already made to this end and intending to give every encouragement to further steps by such companies to combine their efforts,

(*a*) Agrees in principle that the Community will undertake and finance in common a limited number of major joint development projects of international character in the field of applications, these to be followed by others as needs are identified.

(*b*) Intends to give a community orientation to policies for encouraging and promoting data-processing, in particular by collaborating in procurement policy, standards and applications and notes the Commission's intention of arranging progressively the most appropriate procedures for realising these objectives.

(*c*) Considers that it is desirable to develop a systematic Community programme for the industrial development and application of data processing, once the evolution of industrial structure permits, with the central aim of establishing, by early 1980s, a strong and viable european based industry.

(*d*) Will take decisions in the meantime on selective proposals which the Commission might present for common financial support for key collaborative industrial developments.

(*e*) Notes the Commission's intention, after appropriate consultations, of presenting first detailed programme proposals notably on the actions under a), b) and d) during 1974 with a view to decisions by the Council by the end of the year and of preparing a progress report on the data processing sector in the Community by the end of 1975.

DOCUMENT III

Annex I—Economic Data on the Computer Market

1. Growth rate.

(*a*) "The growth rate of the computer industry is estimated at about 20% per annum for the coming decade:

15% in the US, 20% in Europe and 30% in Japan.

It appears certain that between 1970 and 1980 it will become the third largest industry in the world, after the oil and motor car industries."

(Source: Fourth Report from the Select Committee on Science and Technology, Session 70–71 (Volume 1)).

(b) ESTIMATE OF THE DATA-PROCESSING MARKET, INCLUDING SOFTWARE AND SERVICES

[Turnover in millions of dollars]

	1970		1975		1980	
	Total	Services	Total	Services	Total	Services
Europe	3,900	470	8,100	1,500	12,850	4,600
United States	10,650	3,345	22,136	9,750	36,600	20,800

Source: Diebold 1972.

(c) FORECASTS FOR THE COMPUTER MARKET IN EUROPE AND THE WORLD

[In millions of dollars]

Central units	1960	1965	1970	1975	1980	1985
World	1,315.0	2,445.0	3,500.0	6,672.0	9,533.0	13,028.0
United States	953.0	1,917.0	2,205.0	3,684.0	4,587.0	6,068.0
Western Europe	265.1	345.4	693.0	1,456.6	2,346.4	3,126.0
Of which—						
West Germany	70.4	77.8	184.2	383.1	605.4	758.4
France	49.3	67.7	140.8	292.8	464.0	639.6
Italy	24.2	41.5	70.0	148.6	246.7	345.7
United Kingdom	59.7	69.7	138.7	272.4	410.7	525.8
Other countries	61.5	88.7	159.3	359.7	619.9	856.5

Peripherals	1960	1965	1970	1975	1980	1985
World	1, 651. 0	3, 192. 0	6, 128. 0	13, 784. 0	23, 052. 0	38, 394. 0
United States	1, 190. 0	2, 333. 0	3, 644. 0	7, 117. 0	10, 115. 0	16, 238. 0
Western Europe	414. 1	612. 2	1, 384. 8	3, 339. 9	6, 409. 5	10, 465. 5
of which—						
West Germany	109. 8	136. 3	372. 3	893. 9	1, 653. 7	2, 543. 1
France	76. 9	120. 4	284. 5	633. 2	1, 269. 1	2, 145. 4
Italy	38. 0	73. 7	135. 3	346. 7	673. 0	1, 161. 7
United Kingdom	93. 3	123. 9	280. 3	635. 6	1, 121. 6	1, 758. 2
Other countries	96. 1	157. 9	312. 4	839. 5	1, 692. 1	2, 857. 1

Source: Electronic Industries Association—An economic, technological, political, and social look ahead at the electronic industries, May 1972, sec III, the electronics industry in 1985).

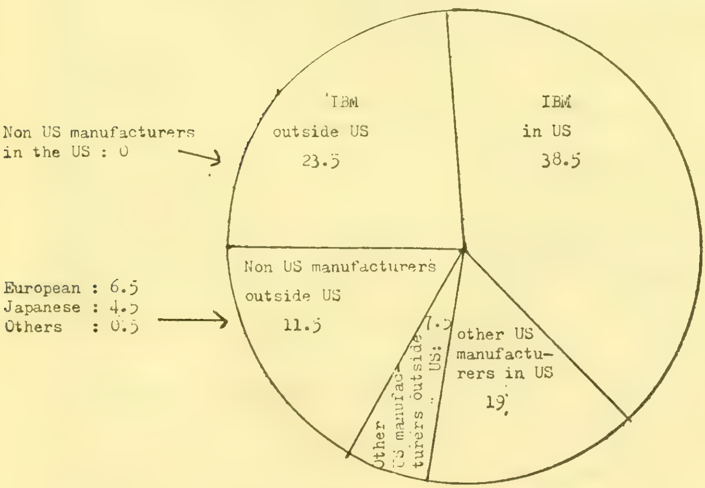
(D) ESTIMATED GROWTH RATES FOR 5 YEARS

[In percent]

	1970-75		1975-80	
	Europe	United States	Europe	United States
Central units	110	67	61	25
Peripherals	146	95	89	42
Services	219	191	207	113

2. The main manufacturers. .

(a) Breakdown of the value of installed capacity at 1.1.1972 (Base 100).



(Source : Délégation à l'Informatique, Paris).

(B) BREAKDOWN OF THE WEST EUROPEAN COMPUTER MARKET BETWEEN THE MANUFACTURERS

[Expressed as percentages of the value of the installed capacity]

	IBM	HIS	UNIVAC	Burroughs	CDC	ICL	CII/Siemens Philips	Others	Percent
Germany	57	8	3	3	3	0.5	16.5	9	100
Great Britain	38.4	7	3.7	3.9	1.8	34.7	.9	9.6	100
France	57.5	18	3.5	1.5	3.5	3	12	1	100
Italy	73	11	7	2.5	2.5		2.5	1.5	100
Benelux	60	9.5	5	4	4	3	8	6.5	100
Others	65	6	4	3.5	4.5	5	2	10	100
Total (percent)	59.47	10.0	4.4	3.12	3.27	7.83	6.93	4.85	100

Source: Delegation a l'Informatique, Paris 1972, Department of Trade and Industry, 1973.

3. NATIONAL HELPS AND OTHER SUPPORTS IN THE COMMUNITY

[In millions of u.a.]

	Hardware	Applications
Belgium: 1971–73	(1)	4.0
France:		
1967–70	109	7.2
1971–75	158	29.0
West Germany:		
1967–70	66	15.6
1971-75	190	150.0
United Kingdom: 1968 to September 1976	(2)	(2)

1 Maximum 25 percent of public contracts to Phillips and also to Siemens.
2 Support for ICL—difference 144.

Note: Estimated IBM expenditure on R. & D.—about 6 percent or its total revenue or $400,000,000 to $500,000,000 per annum.

Source: National delegations and 4th report from the Select Committee on Science and Technology, session 197–71 vol. 1.

In 1965, however, government participation in the USA in R&D on data-processing amounted to 300 million dollars, or 49% of the total R&D in this sector.

Source: Gaps in technology. Electronic computers, table 24 -OECD, Paris 1970.

4. The problems of scale faced by the European computer industry.

A number of thresholds affect the size and viability of a computer manufacturing firm:

The R&D threshold; this is an absolute minimum level of resources necessary to obtain an objective (development of a range of computers).

It is dependent on many factors.

The marketing threshold (services and technical assistance); this demands a minimum volume of sales if the operation is to be economically justifiable. For Europe, this can be put at 5–8% of the European market.

The European market is, at present, divided up as follows:

(In value—source: Financial Times.)

	Percent
ICL	7.5
Unidata	8.0
IBM	55.0
Honeywell-Bull	13.0

The threshold for entry into the world market will be higher than that for the European market.

The "experience curve" indicates that the unit cost of a product is reduced by approximately 15% each time the cumulative volume of products on the market doubles. It can be shown that the unit costs of IBM are about one half of those

of European based manufacturers. The present rate of growth (approx. 20%) of the Community market shows that European manufacturers are already struggling to hold their share of the market. Concentration is the only way of doing better.

Source: Towards a European policy on the EDP industry Y.S. HU, 1973. Study carried out under contract from the Commission.

5. Components:

(*a*) The percentage of the turnover of the electronics industry absorbed by data-processing is as follows (1968):

	Percent
EEC (without the United Kingdom)	19.8
United States of America	23.0
Japan	9.8

(*b*) It is estimated that in 1972 data processing used 31% of the semi-conductors in the EEC (37% in the United Kingdom).

(*c*) On the integrated circuit market in the EEC (without the UK), the market was shared as follows in 1970:

Texas	24	SGS	7
Philips Group	20	AEG-Telefunken	5
ITT Group	15	Sescosem	5
Motorola	9	Others	7
Siemens	8		

Source: La recherche et le développement en électronique dans les pays de la Communauté et les principaux pays-tiers. BIPE study—October 1970.

6. The software industry.

(*a*) It is estimated that in France and Great Britain in 1971 the share of the service companies in the turnover of the software sector came to 35% and 25% by value respectively. (Presse Informatique No. 24 of 4.12.1972).

(*b*) In 1971 there were approximately 1000 service companies in the USA. as against 500 in France and 750 in Great Britain. It is estimated that 3% of the service companies accounted for 57% of the turnover of the sector and that about 40% were running at a loss.

(*c*) Productivity in 1971.

PRODUCTIVITY OF THE SOFTWARE INDUSTRY

	West Germany	United States	France	Great Britain
Turnover (in millons of u.a.)	75	300	51	40
Share of the market held by the 12 main companies (percent)	50	51	70	41
Data-processing specialists employed	4,200	12,000	3,000	4,350
Turnover per man in u.a	17,850	25,000	18,500	9,100
Orders passed by the government (in millions of u.a)		118	4	2.9
Proportion of software (independent companies) be in relation to hardware (percent)		5.4	8.3	8.3

Source: 0.1 Informatique, No 161 B of 7.9.1971. Handelsblatt, 6.3.1973).

7. Share of the data-processing market represented by the public and the ancillary public sector:

(a) Capacity held by the central administrations (1971):

In France: 12% (by number), (Source: annuaire 0.1 Informatique).

In West Germany: 14.6% (by value), (Source: Diebold).

If the ancillary public sector is included, the proportion for Europe is between 20 and 30%.

(b) Service (1971)

In France: 28% of the turnover of the service companies.

In the United Kingdom 23% of the turnover of the service companies.

Source: La Presse Informatique No. 24, 4.12.1972 based on a study by Sesa-Logica.

8. SUMMARY OF PUBLIC-SECTOR DATA-BANK PROJECTS IN THE COUNTRIES OF THE ENLARGED COMMUNITY:

Country	Total number of projects enumerated	Operating or under construction	Operating or under construction					
			Access			Volume		
			Random	Sequential	Combined	Large >10^9c	Medium 10^7-10^9c	Very small <10^7c
West Germany	49	23	14	13	4	4	18	–
Belgium	13	6	1	6	1	1	4	1
Denmark	15	12	2	10	–	1	7	4
France	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Ireland	4	4	–	4	–	1	2	1
Italy	7	7	–	–	–	–	–	–
Norway	18	14	5	11	2	2	10	2
Netherlands	4	2	–	2	–	–	1	1
United Kingdom	20	13	5	10	2	4	5	3

[1] Inquiry being carried out by the Délégation à l'Informatique.

Source: Document OECD DAS/SPR/71.44—Annuaire des banques de données dans le secteur public.

9. Planned expenditure on data communication in the United States up to 1980:

(a) ". . . between now and 1980, the United States will spend 250 thousand million dollars on setting up and developing data processing and telecommunications networks . . .

These networks will be of vital importance if one considers that according to estimates the United States alone will, by 1980, have 2.5 million terminals permitting 250,000 million operations or "calls" per year."

Source: Doc. SP(71)19 OECD.

(*b*) ". . . American experts estimate that, by about 1980, $260,000 million will have been invested, $160,000 million in computer systems and $100,000 million in extending and developing telecommunications networks."

Source: same document, revision 1.

10. Needs for computer specialists:

(*a*) According to the *Second West German Data-Processing Programme*, the manpower needs at the beginning of 1978 will be 250,000–400,000 (operators, programmers and analysts), including 200,000–300,000 for utilization. These figures are based on an average manpower of 6.9–9.0 per computer.

At the end of 1970, computer specialists totalled about 100,000.

(*b*) A study by the BIPE (April 1970) estimates that in France 100,000 new computer specialists will enter the profession between 1970 and 1975. At the beginning of 1970 their numbers were estimated at 70,000.

(*c*) As regards Italy, an AICA study estimates that in the period 1971–80 the number of graduates or holders of equivalent diplomas to be trained for data-processing purposes will be 38,100–54,400, which probably represents about 20% of the total university degrees during this period.

DOCUMENT IV

Annex II—Summary of the Commission's Communication on a Community Policy for Data Processing

1. The effective application and industrial development of data processing is crucial to the European economy; it is the third largest world industry, growing at 20 per cent per year in Europe; its applications penetrate almost every walk of life (§ 1).[7]

2. This industry is, however, dominated by a single firm based outside Europe which has 60 per cent of the world market (§ 2).

3. The Commission has the obligation, under Article 86 of the Treaty, to ensure that there is no abuse of such a dominant position. The best guarantee against abuse is, however, effective competition. A flourishing European data processing industry ought to include a strong European-based element, side by side with the important companies controlled from outside. In an expanding market, there is room for both (§ 2–4).

[7] See corresponding paragraph of document I.

4. To achieve a strong European-based industry, the key need is to develop an industrial structure capable of competing with the dominant producer in the supply of a range of central processors. In an endeavor to maintain a national capability, three governments have supported indigenous companies with finance and preferential purchasing. Given the small size of the European-based enterprises, (they have only 6 per cent of the world market together) there is much evidence that they will need to combine forces, if they are to achieve long term viability, make the best use of available funds and achieve a genuine European, indeed world dimension (§ 5–8).

5. A first welcome step towards this aim has been taken by the formation of the Unidata group by Siemens, CII and Philips. The separate commercial plans of this group and the other major European enterprise, ICL, mean, however, that a further regrouping between them in the near future may be difficult and that the immediate prospect is for two major European Groups competing with each other (§ 9-10).

6. In this situation, Community policy towards the indigenous industry is best seen in two phases: In a first phase, a limited collaboration should be encouraged both for ends useful in themselves and as a means of encouraging a convergence of the companies with a view to a further combination later, which respects the rules of competition under the Treaty. In a later phase, a more comprehensive pluriannual programme for the support of European data processing is desirable (§ 11).

7. A policy towards the data processing industry must take account of the needs of the components, peripherals and software industries, which together account for a large and increasing part of the value of computer systems (§ 11).

8. In what is loosely-called "peripherals", though a variety of European companies have been successful, the overall picture is one of a growing payments deficit and technological dependence. Further consideration needs to be given at Community level to the question whether the industry needs to develop and the Community to support an indigenous capability to produce key sub-assemblies of computer systems (for example disc units) (§ 12-13).

9. In electronic components, it is essential for the European industry to be abreast of the latest technologies, notably in the field of memory technology and especially Large Scale Integration. Further consideration should be given to the possibility of joint support for a common development and production capability, even during a period in which the major companies are apart (§ 14-15).

10. In software, there is a need to develop a "market" in transferable software packages and to support the development of programmes which enable users to switch from one type of equipment to another. The best way for the Community to stimulate the growth and strength of the software industry would however be to sponsor one or more major international development projects which stretch its capability (§ 16-19).

11. Side by side with the objective of strengthening the European based industry, the Community should promote collaboration between users, particularly public ones, with a view to applying data-processing more effectively to society's needs (§ 21).

12. In the United States, the market provided by Federal Government procurement has not merely served users but spurred and stretched the industry. In Europe, procurement policies need to be combined at Community level with the dual aim of providing analogous opportunities for the European based industry and achieving economies for users by joint purchasing and development (§ 22-24).

13. In the field of applications, collaboration on three levels can bring benefits:

(*a*) certain applications have a basic international character (air traffic control, environmental monitoring, meteorology, customs and trade statistics, air, sea and rail freight systems for example). Major development projects in such areas could also provide an impetus to the development of the European-based industry. A small number of such projects should be undertaken, as soon as project selection, planning and organization can be completed, to be followed by others as the need arises (§ 26).

14. (*b*) In some areas, where common needs exist, further savings may be achieved by specifying requirements together, and jointly developing programmes or systems which can then be used, in whole or in part in several states: medical systems, social security records, urban traffic, control and management are examples (§ 27);

15. (*c*) In many areas coordination of national policies may bring economies and greater efficiency: Data-communication and the management of data banks are priority examples (§ 28–31).

16. International projects as suggested in 13a above would be appropriate subjects for common financing as would common [8] development contracts to industry carried out jointly by common subsidiaries. The Commission when examining national aids under Article 92 of the Treaty has accepted that in the present circumstances, existing aids to the overall R & D efforts of the major national companies should continue. However, in the later context of an overall programme for Europe, providing support on a temporary basis for a regrouped industry, a larger element of common finance would make sense (§ 44).

17. There is a need to develop and apply common standards, notably in the fields of high level languages and electronic interfaces, in the interests of both users and the industry as a whole. A combined public procurement policy at Community level can be an important instrument for gettting such standards applied (§ 34–35).

18. Collaboration or joint action will be needed in a number of other fields, including education, training of personnel, fundamental research, protection of software, and support for leasing. The Commission will make appropriate proposals at a later stage (§ 36–37).

19. The Commission intends to follow closely the evolution of the structures of employment, implied by the implementation of a Community policy, taking special acount of the needs of regional policy (§ 38).

20. A wide debate is necessary on the subject of the privacy and protection of the citizen, with a view to the development of a Community policy in this field. Public hearings are recommended (§ 39).

21. In the light of this situation, the Commission proposes that the Council resolve to encourage and support further associations between the companies, to give a Community orientation to policies for encouraging and promoting data-processing, notably by collaborating in procurement policy, standards and applications, and to decide on a limited number of major common development projects in the field of applications before the end of 1974. The Commission will present a progress report on the evolution of the sector before the end of 1975 (§ 40 to 45 and resolution).

Exhibit 3.—*Turnover of main European computer companies in millions of dollars*

Name of company	*1973*
Unidata:	
Siemens	305.6
Philips	180.5
C.I.I.	138.8
Total Unidata	625.0
I.C.L.	404.6

NOTE:—At 1973 rates of exchange.

AFTERNOON SESSION

Senator HART. The committee will be in order.

Our first witness this afternoon will be Alain Nicolaidis. He is the scientific attaché of the Embassy of France. Today he will deliver the statement prepared by Maurice Allegre. We are sorry that Mr. Allegre could not testify personally, but we are grateful to him for the preparation of the statement. I appreciate further the cooperation of the French Government in permitting us to have its view of this important industry.

We welcome you, sir.

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[8] See footnote § 13 Document I.

STATEMENT OF ALAIN NICOLAIDIS, SCIENTIFIC ATTACHÉ, COMPUTERS, EMBASSY OF FRANCE, WASHINGTON, D.C., ON BEHALF OF MAURICE ALLEGRE, DELEGUE A L'INFORMATIQUE, FRENCH GOVERNMENT

Mr. NICOLAIDIS. Let me start off, Mr. Chairman and members of the subcommittee, by saying that Mr. Allegre is very sorry not to be able to appear before you himself. Since I'm scientific attaché in charge of the computer field at the French Embassy in Washington, Mr. Allegre asked me to read the statement that he had prepared; and if you wish, to answer your questions about the computer market and industry in France, on behalf of the Delegue a l'Informatique, which is, as you know, the government agency in charge of computer policy for France. As you will see, this statement is not related directly to a monopoly problem; not against IBM, despite Mr. Katzenbach's statement about the two fellows from overseas; but explains the trends of French policy in the computer field because we think that what is known in France as the "plan calcul" is an interesting approach to the problem risen by the domination of a very powerful firm on a specific sector of the industry.

This is Mr. Allegre's statement:

PREPARED STATEMENT OF MAURICE ALLEGRE, DELEGUE A L'INFORMATIQUE, FRENCH GOVERNMENT

In the first place, France wishes to stay in the leading group of advanced countries, and must therefore develop the efficient use of computers coherently throughout her economy. Next, as an industrial nation our country must develop a computer industry just as, in the first half of the century, she felt it essential to learn how to harness electrical energy. Thirdly, and finally, we intend to make clear the role our country must and can play in the world effort.

To start with, I shall develop the first proposition: That an efficient and coherent policy on the use of computers is indispensable to the growth of a country wishing to develop itself.

This idea is relatively recent in France, and it was only in 1966, with the creation of the "Delegation a l'Informatique", that such a mission was entrusted to a government organization in our country. Up until then, computing had developed spontaneously—indeed, anarchically—in the whole of our economy and particularly within the administration.

The technique certainly hasn't grown under ideal conditions, but even so we have in France today more than 10,000 computers installed, worth some $4 billion.

The computer industry being largely in the nature of a service, accompanies economic development and must contribute to making it more efficient and—what is often forgotten—more human. These considerations apply directly to the use of computers in the administration, which represent about 20 percent of all installed capacity.

In certain circumstances the use of computers can usefully lead economic development rather than follow it. In medium to small businesses, for example, we are promoting their use in cooperation with the Secretary of State for Medium and Small Industry.

Similarly, computers are as obviously useful to certain developing countries as are airplanes where no roads exist. They can make a decisive contribution to indispensable exchanges of information where present methods are inadequate. In this respect, France is keen to foster, and has effectively initiated, an original cooperation with certain of those countries on computing matters, and believes this to be a most useful international contribution.

Finally, one cannot neglect the very fundamental problem of training computer specialists. Without going into detail, the policy of the Delegation is closely coupled to that of the national education, and has two main aims:

To integrate teaching about computing into the whole educational system as a general cultural discipline. In this connection the Ministry of National Education has taken a most important decision to progressively bring into teaching at the secondary level introductory courses in computing.

And, to adopt quantitatively, and above all qualitatively, the supply of specialists to the needs, particularly the substantial needs, of business users.

The second proposition that I put forward earlier can be summarized as follows:

A computer industry is a major factor in the development of a modern economy.

It combines three characteristics not often seen together. It is at once a mass-production industry, a high-technology industry, and a key industry.

A mass-production industry by virtue of its 1973 worldwide revenues of around $30 billion.

A high-technology industry because the very rapid technical evolution of the industry has been both the result of and the reason for research expenditure of between 10 and 25 percent of revenues according to the size of business involved.

A key industry for two reasons: Because the use of computers is becoming more and more important to decisionmaking, it is more and more a high-level activity. The industry has an impact on a great number of activities which it supplies, and itself diffuses effects to its suppliers. Thus, a country which fails to master its computing technology gives away to a considerable degree the future of the electronics components industry and even of the electronics industry itself.

This is why, besides foreign industries operating in our country, we think it is necessary to have a truly national computer industry. To this aim, the Government has maintained close liaison with private industry for the last 7 years; promoting, on strategic grounds, the growth of a national computer industry, which was, sadly, lacking in 1966.

Before launching what quickly became known as the "plan calcul" some preliminary thinking—the correctness of which has been since demonstrated—was necessary to define the aims to be achieved. It was essential to avoid certain impossible choices, despite their seductive appearance. The first such impossibility would have been to concentrate on software, at the expense of hardware. Some advocated a national policy of support for software, exclusively, since hardware could easily be procured from foreign suppliers. Not only would this deprive industry, and particularly the electronics industry, of the irreplaceable stimulus afforded by the use of computers but also it would lead rapidly to the software firms becoming closely dependent on the manufacturers. Keeping them in a state of controlled backwardness would be all the more damaging because the manufacturers are, of necessity, the most important suppliers of applications software. Hardware and software constitute two facets of the same industry. They are inseparable and each as important as the other. The object must be to end up mastering the whole technique of information systems for the future.

The second impossibility was to choose a specialized strategy by, for example, supporting only small computers, more suited to our capacity at the time, and offering a better chance of success and profit.

Such a strategy would not have been acceptable to France any more than to Europe as a whole. Such a choice would prevent a country such as ours from assuming the major responsibilities its industry must undertake.

The French computer industry must be capable of designing, building, and selling competitive products in a very competitive international market. The "plan calcul" is not a prestige operation. Its aim is to develop a private industry able to keep its place in the world scene.

The "plan calcul" is essentially an industrial operation, based on a new mechanism for state intervention, but using the minimum of direction by the state. This form of intervention is exercised through the Delegation de l'Informatique under the authority of the Minister of Industry and Research.

The aim of developing a viable private industry has been mainly promoted by the public sector through support of CII—Compagnie Internationale pour l'Informatique. This objective was first given to the company in April of 1967 and has been endorsed and enlarged in scope since August of 1971, when the state agreements with CII were negotiated for a further 5 years.

Here let me briefly review what has been achived. In 5 years, CII, a subsidiary of a consortium of Thompson-CSF—who provides the management—Compagnie Generale d'Electricité, and Schneider, has realized both qualitatively and quantitatively the aims of the first agreement in launching on the market a range of computers of medium and large size, oriented toward business use, which represents three-quarters of current computer applications; has been able to get roughly 20 percent of the French market for new shipments in 1973; has grown very rapidly, and now, with an effective work force of more than 8,000 people, can see attractive prospects opening up outside France, which I shall come back to in a moment.

Besides CII, I should underline the existence of well-developed companies offering services and consultancy on computing, and of small- and medium-size companies making small computers, peripherals, and terminals. Some of these companies show remarkable enterprise and their activities have already gone beyond the national framework. At the same time, public support of research has been accentuated.

These, then, are the proofs that a French computer industry really exists today.

I have tried to show why our country could not do without such an industry. Seven years of work, received at best with a condescending smile and more often with harsh criticism, enable me to say that today the French computer industry exists, not by chance, but by necessity.

But the future of the French computer industry can only be properly appreciated in an international context.

Our country has a role to play in the world development of computing.

The size of the financial resources and number of people needed to create a major computer industry, and the evident necessity to reach a critical level of importance, has put about the idea that a medium sized country cannot alone build up such an industry. Moreover, the importance of such a development has long been contested; as a technique transcending national boundaries, computing requires an internationally based industry and, in support of this argument, the exemplary success of the very powerful American company which dominates the world industry is cited.

In this connection, a new word has been coined: the word "multinational".

Allow me a brief personal digression: Before being in computing, I was in the oil business and the terminology then reserved for those large businesses which produced and refined oil in the four corners of the planet was "an international company."

What was and is still—of course—the essential characteristic of those companies? An industrial and commercial business internationally distributed but directed from a main decision center situated in one country alone. I see no reason to call them "multinational." Nevertheless, one such company does act differently: Royal Dutch Shell, which has two decision centers, one in London and one in the Hague, cooperating closely, but with distributed responsibilities, so that neither is subordinate to the other.

In my opinion, it is this characteristic which should distinguish a multinational company from an international company.

Royal Dutch Shell is, in my sense of the word, a multinational group or, more precisely, "binational," which should serve as a model for a European computer industry.

A strategy comparable to the "plan calcul" is not the prerogative of our country. Britain, Germany, and Japan have all done something similar. This economic strategy has affirmed the right of a national computer industry to exist, as a necessary guarantee of the independence of a country and of its autonomy to grow.

It doesn't deny the necessity of international cooperation, but two conditions are necessary: That such cooperation is conducted as between equal partners and that it does not end finally in a loss of control by one of them of the key elements of its computer industry through, for example, their transfer abroad.

In other words, if one day a truly multinational industry is to exist, it can do so only on the basis of national firms.

In 5 years, CII has established itself in France as a truly national computing firm, endowed with all the attributes of a major firm.

The second "plan calcul," which started officially on August 2, 1971, with the signing of a new agreement between the state and CII, has seen the creation of the first truly multinational group in European computing.

An authentic multinational group must combine the advantages of both a national and an international company while eliminating the weaknesses and inefficiencies of each.

Its constitution must result from the association of firms of different nationalities whose level of development and size are comparable.

The firms making up such a multinational group must accept a common view of their growth strategy, and this must involve sharing responsibilities equally for research, production, and marketing, while each firm keeps its own personality and retains in its own country control over the key points of its development.

In this way national aspirations are able to continue within a more extensive international framework.

This aim, which could be regarded as merely theoretical, took a practical form last year with the signing in July of an agreement between CII, Siemens, and Philips—giving birth to Unidata—which fully endorses the criteria for true multinationality set out above. This was an important event which laid the foundations for a group both multinational and European in the computer field.

Thus, having started out with a national policy which was not nationalistic, we emerge with a truly multinational policy on a European scale, which we hope will broaden its base, particularly by tying in with the British.

The resolution of the EEC Minister's Council in Brussels a few weeks ago, giving a strong support to such policy, shows that French, German and British were right when they decided to set up their own "plan calcul" policy.

So Europeans intend to bring to maturity a large industrial group, able to take place in the worldwide competition on a sound eocnomic basis.

In conclusion, a single path was open to France to play an eminent role in world computing affairs, a path that certainly seemed difficult, but today's results speak for themselves. We have just turned an important page in the register of births of European computing. Our hope is to contribute in this way to the building of Europe itself.

Senator HART. Thank you very much.

Mr. CHUMBRIS. Mr. Chairman, before Mr. Nash gets started with questions may I interjet. Mr. Nicolaidis, you stated that "The resolution of the EEC Minister's Council in Brussels a few weeks ago, giving a strong support to such policy, shows that French, German, and British were right when they decided to set up their own plan calcul policy." Now unless I misunderstood I think Mr. Nash asked the previous witness the question. What would EEC do if a cartel type of arrangement was made between the three companies as Unidata says. Is that inconsistent with what the previous witness states?

Mr. NICOLAIDIS. Yes; it was just the kind of policy we made through the plan calcul because there was no agreement at that time, from the European point of view, that it was the right policy. So now, not only is it a national policy but it could be considered as a European policy.

Mr. CHUMBRIS. In your view, do you feel that you would not be violating anything that would bring the wrath of the EEC upon you?

Mr. NICOLAIDIS. I don't think so.

Mr. NASH. Just for the record I wanted to clarify your problem——

Mr. CHUMBRIS. It's not my problem. It's the subcommittee's problem.

Mr. NASH. Just for the record I want to note the plan calcul of the French is not cartel in the traditional sense of the word "cartel."

Mr. CHUMBRIS. I thought that's the word you used when you said it earlier.

Mr. NICOLAIDIS. I think when you speak about cartel you have to have one center of decision. That is not the case. It is just a point venture in the marketing organization and the decision to build a full compatible line of computers. For example, the first computer which was announced by Unidata was made by Philips. It is a small

one. And two others will be announced in October—one built by CII, the largest one; and another one built by Siemens. But the main characteristic is that they are all compatible.

Mr. CHUMBRIS. You answered my question. As far as you are concerned you believe that you will not be violating anything under EEC laws and regulations. We will have to let the record speak for itself as to the colloquy between Mr. Nash and the previous witness.

Mr. NICOLAIDIS. Yes. I think the issue is the share of the market you can have within Europe itself. At this moment it is far from having a dominant position in Europe.

Mr. CHUMBRIS. Thank you.

Mr. NASH. Mr. Nicolaidis, it would be helpful for the record if you would indicate the relative market shares of the French computer market held by some of the other companies. You can start with the market shares held by the largest and work in descending order. We would appreciate that.

Mr. NICOLAIDIS. In France?

Mr. NASH. In France.

Mr. NICOLAIDIS. If you are speaking about installed base I have these figures. At the beginning of the year 1974: IBM has 56 percent; Honeywell, 15 percent; Unidata, 11.8 percent; Control Data, 4.5; Univac 3.5; Burroughs, 3.5; ICL, 2.2; and NCR, 1 percent. This is for the installed base. If we speak about the shipments during 1973, in France: we have IBM, 53 percent; Unidata, 18 percent; Honeywell, 14 percent; and Univac, Control Data, Burroughs, ICL, NCR—altogether—have 13 percent of the market.

Mr. NASH. You indicated that prior to 1966 France had no national strategy designed to promote the computer industry and plan calcul was then developed with that aim. It has been our impression that around 1966, or shortly before then, the U.S. Government declined to grant an export license for the sale of Control Data Corp. computers that the French Government had sought to purchase for utilization in its nuclear development program.

Mr. NICOLAIDIS. That is true.

Mr. NASH. I was wondering if you could indicate the extent to which that refusal of export license was a factor in the decision made by the Government of France to develop a national computer industry.

Mr. NICOLAIDIS. I think it is certainly one of the reasons why France started plan calcul. Because, at that time, the French Government needed these big computers to develop nuclear weapons, and of course, the refusal of the United States to allow Control Data to sell them was one reason. Another reason was the overtaking by General Electric of Bull, which was a French firm with a pretty good share of the market—European market—at that time. So, suddenly, France was without any national computer industry in the main-frame business. I think these are two reasons; but I think, above all, the feeling that a country cannot accept having no control at all over a key industry was, in fact, a major factor. Because, for example, the two first reasons didn't exist in Germany or England and they have launched a kind of plan calcul. So I think that the main reason is the problem of—as Mr. Allegre explained in his statement—the necessity of having a possibility of control over a key sector of the industry. And, for example, Mr. Katzenbach, himself, recognized in his statement that the aims of the French Govern-

ment and those of IBM are not supposed to be the same in any circumstance: and that is true.

Mr. NASH. Having brought the latter points up, my next question is, to what extent, if at all, was the French decision made because of a concern over IBM's share of the computer market?

Mr. NICOLAIDIS. Speaking about having a degree of control over this industry, the big share of IBM was a key factor; because, at that time—I think, I'm not sure of the figure—it was between 70 and 80 percent of the market. So, of course, the dominant position of IBM in France was a focal point of studies about the problem of control.

Mr. NASH. You have mentioned three factors so far. Are there any other factors that went into the decision to implement "plan calcul" that you can recall?

Mr. NICOLAIDIS. I think that it is very difficult to enumerate the specific factors because I think it was much more a matter of currents of ideas. That came in 1966—and I have mentioned the specific reasons, but I think it is more general.

Mr. NASH. Some U.S. computer manufacturers have indicated that "plan calcul" involves the French Government subsidizing CII. Would you be able to give us an indication of the extent of the subsidy?

Mr. NICOLAIDIS. Yes, I can give you the budget of the Delegation a l'Informatique because all the money is going through the Delegation. The budget of the Delegation a l'Informatique for 1974 is $62 million, of which $48 million are for computers and systems, generally; $9 million for electronic components, peripherals, terminals; and $5 million for software and education in the computer field. Another sum of money, about $12 million, is under discussion with CII for the charges related to the Unidata group—some transformations needed to make the CII line compatible with the standards established with its partners within the Unidata group—but this is not decided at this time.

[For further explanation of the above subject see exhibit 2 at the end of Mr. Nicolaidis' oral testimony.]

Mr. NASH. To what extent do you believe the French Government has a degree of control over multinational computer firms operating in France?

Mr. NICOLAIDIS. No control at all. No real control at all because IBM-France, for example, is legally a French firm; but, in fact, IBM-France doesn't exist by itself because it needs the other IBM plants in Europe to build a computer. In France the main job of IBM-France is to build the electronic components for other plants of IBM.

Mr. NASH. I understand that a large number of U.S. minicomputer companies of late have successfully penetrated the French computer market. Is this also a concern to the French Government?

Mr. NICOLAIDIS. Not at the present time. They are doing very well, but it is not a matter of control. The market involved is not as big as for IBM. Until now the French Government has always allowed the U.S. minimakers to put a subsidiary or plants in France.

Mr. NASH. When you say it's not a matter of control you mean a single company controlling a large share or a combination of companies controlling?

Mr. NICOLAIDIS. No, I think it is more a problem of one company.

Mr. NASH. Thank you, Mr. Chairman. I have no further questions.

Senator HART. Mr. Chumbris?

Mr. CHUMBRIS. I have no further questions other than the point I raised, Mr. Chairman. Thank you, again, for coming and giving us this information.

Senator HART. Thank you very much. I'm sorry that we had to bring you back. This does conclude our hearings today. We resume in this room, not at 10 o'clock as indicated on the earlier announcement, but at 9:30 in the morning. Tomorrow, in addition to those listed, we will have testimony from the president of Sanders Associates.

[Whereupon, at 2:35 p.m., the subcommittee adjourned, to be reconvened on Thursday, July 25, 1974, at 9:30 a.m., in room 2228, Dirksen Senate Office Building.]

[The following was received for the record.]

MATERIAL RELATING TO THE TESTIMONY OF ALAIN NICOLAIDIS

Exhibit 1.—*Subsequent Letter From Alain Nicolaidis re French Government Subsidies to the Computer Industry*

AMBASSADE DE FRANCE AUX ETATS-UNIS,
Washington, D.C., July 25, 1974.

Mr. BERNARD NASH,
Assistant Counsel, Subcommittee on Anti-Trust and Monopoly,
U.S. Senate, Washington, D.C.

DEAR BERNIE: First, I would like to add, for the record of the computer hearings, some precisions to my answer yesterday to your question about subsidies from my Government to the French Computer Industry.

I think the word "subsidy" is, in the mind of many Americans, just an aid without counterpart like the subsidies our governments both give to the farmers, for example, I want to say that the "subsidies" we spoke about, in the case of the computer industry are, in fact, R & D contracts: the Délégation à l'Informatique" gives to CII, for example, such or such amount of money to develop a model of computer, or an operating system, or a peripheral. It is really a contract between the French Government and CII which is similar to the many contracts the Federal Government makes with many computer firms in this country (whose amount was 300 million dollars in 1965, as Mr. Christopher Layton said yesterday).

As an example, AMPEX—a firm I visited some months ago—received in 1973 2 million dollars from the Department of Defense for the development of a mass memory, known as the TERABIT memory, which is not a specific device and which will be marketed as any other product of this firm.

Secondly, I would want you to add to the record of my testimony a statement (enclosed) about the so-called nationalistic policy in the procurement of computers for the French Government. I think it is very important because many people in this country think CII has a monopoly in the government market.

Very truly yours,

ALAIN NICOLAIDIS, *Scientific Attaché.*

Enclosure.

I have often heard it is said that the French Government has a very nationalistic policy in the procurement of computers for its Departments and Agencies.

Let me make two remarks:

(1) Before being there I was head of a computer center in a French agency, the "Direction des Constructions Navales" which is a government-owned industrial organization of about 25,000 employees in charge of designing, building and repairing all the ships of the French Navy.

We had a lot of computers in our eight shipyards and, as a head of the central computer center I had some responsibility in discussing the choices we made in the procurement of computers. I had to explain why we needed a new computer, why we made such and such a choice, how we made the technical evaluation and so on before a special commission which exists in each Ministry. One of the members of that commission is a representative of the Délégation à l'Informatique. But I can say that we proposed for our needs, on the basis of cost-effectiveness, one computer from CII and four computers from SIEMENS

which at that time was just a foreign supplier as any other because UNIDATA did not yet exist. I experienced no opposition from the representative of the Délégation : CII had lost on a competitive basis and the Délégation wants only to be sure that CII has a fair possibility of competing. In other cases, CII wins because I must say that they have very good computers in some specific ranges and their performance in other countries is a proof of that (CII exports about 20% of its production).

Of course if CII is just fairly competitive, it has the preference of the French Government, but in this case only.

On the other hand, do you really think any foreign manufacturer has a fair chance to compete in a bid for the Federal Government?

(2) The structure of installed base in the French Government shows that the share of U.S. manufacturers is still enormous :

	Percent
CII	22
U.S. manufacturers	74
of which IBM	41
Honeywell	16
CDC	7

If we look at the shipments to the French Government for 1973, we can see that there is diminution of revenues, compared to 1972, for the U.S. manufacturers, but not enormous:

	Percent
IBM	—1
Honeywell	—4
CDC	—1

On the other hand, in the nationalized sector (Société Nationale des Chemins de Fer, Electricité de France, Renault, Etc. . . .) also controlled by the French Government, IBM has lost 1% of its share (56% to 55%) but Honeywell gained 2% (7% to 9%) between 1972 and 1973.

This explains that the "Délégation à l' Informatique" has no real power (and no intention) to oblige the French Agencies and Departments to buy only French computers.

It is true that the Délàgation wants to improve the share of CII but it does not want to give CII a protected market because it thinks it is most useful for CII to have to compete on a cost-effectiveness basis.

THE INDUSTRIAL REORGANIZATION ACT (S. 1167)
(The Computer Industry)

THURSDAY, JULY 25, 1974

U.S. Senate,
Subcommittee on Antitrust and Monopoly
of the Committee on the Judiciary,
Washington, D.C.

The subcommittee met at 9:30 a.m. in room 2228, Dirksen Senate Office Building, the Honorable Philip A. Hart (Chairman of the subcommittee) presiding.

Present: Senator Hart.

Staff present: Howard E. O'Leary, Jr., chief counsel; Bernard Nash, assistant counsel; Patricia Bario, editorial director; Janice Williams, chief clerk; Peter N. Chumbris, minority chief counsel; Charles E. Kern, II, minority counsel; and Michael Granfield, minority economist.

Senator Hart. The committee will be in order.

This morning our first witness will be Mr. Eugene K. Collins, director of research for the Wall Street firm of Evans & Co.

STATEMENT OF EUGENE K. COLLINS, DIRECTOR OF RESEARCH, EVANS & CO., NEW YORK, N.Y.

Mr. Collins. Senator, I appreciate the opportunity to appear before the subcommittee.

My name is Eugene K. Collins. I am director of research and a security analyst specializing in the computer industry at Evans & Co.

My undergraduate work was done in electrical engineering and economics, and I studied investments and finance at New York University, Graduate School of Business.

I have been a security analyst at New York Stock Exchange firms since 1965, initially following high technology companies generally, and aerospace and office equipment companies specifically.

Since 1968 my analytical work has been almost exclusively in the computer industry, except for a brief period during 1971–72.

My analytical work in the computer industry has focused primarily on IBM and on young companies in the industry that might be able to successfully penetrate the industry.

My interest in young companies in the industry and in IBM are closely related disciplines since IBM is the computer industry and the business practices of IBM largely determine the economic structure of the industry.

I regularly advise companies in the industry on the subject of future financing plans and I successfully raised initial capital for a company in the industry.

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In 1968, I was instrumental in first introducing peripheral subsystems manufacturers to Wall Street and to financial institutions as potentially attractive investments in the industry; and have closely followed the rise and fall of those companies as meaningful competitors in the industry.

I am generally regarded as Wall Street's resident expert on computer peripheral equipment manufacturers.

In my current capacity as a security analyst at Evans & Co., I act as a consultant to banks, insurance companies, and mutual funds on the subject of investing in the computer industry; and I publish extensively on the industry and on individual companies in the industry.

Many of my remarks today will reflect impressions that I have received through almost daily contact with major financial institutions over a period of 6 years.

The computer industry is the fastest growing major industry in this country and in the world. The industry has already contributed to vast social, economic, and political change in its brief 20-year history; and the next 20 years promise to be even more dynamic because of quantum leaps in semiconductor technology, the increased sophistication of the computer user, and the marriage of computer and communications' technologies.

Yet, there are very few companies in the computer industry that receive serious investment consideration today. The answer to the apparent paradox of a growing and dynamic technology-based industry and the highly selective nature of current investment interest can be found in the structure of the computer industry.

There are two major barriers to entry into the general purpose computer industry: the "systems lock" and the highly capital intensive nature of the industry.

Together they form an absolute barrier to entry that would allow IBM to control virtually 100 percent of the general purpose computer market, in my opinion, if IBM did not operate under self-imposed constraints that limit its market share to 60 to 70 percent.

Basic to establishing and maintaining the two principal barriers to entry is IBM's policy of marketing a total bundled system on a short-term, risk lease basis.

Testimony before this subcommittee has extensively addressed the esoteric subject of the system lock and IBM's related marketing support activities.

The perspective I hope to bring to these hearings is the unique importance of the financing question of the structure of the computer industry; and some insight into how the highly capital intensive nature of the industry is created and maintained to provide an effective barrier to entry.

Although the ability to raise capital is an important consideration in determining real and potential future competition in any industry, it is a uniquely important factor in the general purpose computer industry.

Its unusual importance to the computer industry relates to IBM's practice of marketing a total bundled computer system on a rental basis.

In my prepared statement is an example that shows the first year of operation of two identical companies, with one shipping on an out-

right sale basis and the other shipping on a rental basis, or lease basis.

The manufacturing company that is forced to ship its product entirely on a rental basis records a first year operating loss of $36.9 million on shipments of $100 million, in contrast to a profit of $20 million for the typical manufacturing company.

If no new product were shipped on a rental basis in the second year and expenses were reduced accordingly, revenues of $25 million would be recorded for the rental-based manufacturer and a profit would be realized.

But, that would be a company in liquidation. If, on the other hand, the management of the company addressing a rental market was attempting to build a viable company over the long term, shipments could not be reduced to zero in the second year but would, in fact, have to be increased on a year-to-year basis.

Increased shipments on a rental basis, in turn, result in an even larger reported loss in the second year and increasing losses for some time.

Eventually, the losses peak and begin to decline gradually until, finally, a break-even level is reached.

The problem from a financing point of view is enormous. An investor is being asked to commit capital to a business that may not show a profit for perhaps as long as 10 years; and will only show a profit at that time if management does not make any important mistakes along the way; if the economy does not slump into a recession at the wrong time; if the dominent company in the industry does not become sufficiently concerned to focus its competitive strengths on the new company; and if capital can be raised along the way to keep the company alive.

The capital that must be raised is also equity and equity-related risk capital since straight debt will not be made available to a company realizing a negative cash flow and operating at a loss.

Consequently, most of the companies that have attempted to enter the general purpose computer market have been involved in other businesses that could support some of the initial capital demands, such as General Electric, Philco, Bendix, NCR, Burroughs, Sperry Rand, RCA, and Honeywell.

This history of the general purpose computer industry clearly establishes that reaching the critical mass level necessary for successful entry takes a long, long time and huge amounts of capital.

In September 1971, RCA announced that it was withdrawing from the general purpose computer field, and the company took a pretax loss that year of $490 million as a result of its venture into computers.

RCA had already committed capital well in excess of the final write-off of $490 million; and estimated at the time that it would have to commit an additional $500 million to establish RCA as a viable company in the computer industry.

General Electric's experience was similar; and in 1970 GE sold its computer systems operations to Honeywell.

Even among IBM's systems competitors that have survived, it is unclear to what extent they have successfully entered the general purpose computer systems market.

The data in the table in my prepared statement raises questions about the staying power of some of the remaining companies in the industry. Burroughs is the only company that realized profit margins in 1973 that were in excess of the average of all major U.S. corpora-

tions last year, although Univac was just slightly below the average; and all of IBM's competitors realized a lower return on stockholders' equity in 1973 than the average of all major U.S. companies last year.

The relative difference in profitability within the computer industry is even more significant than the comparisons indicate, since IBM's accounting for profits is in general more conservative than competition.

Also, total corporation data masks the low level of profitability of computer systems operations in many cases.

Since capital is a major barrier to entry into the computer industry, the ability to internally generate cash to meet future capital requirements is an important measure of the ability of any company to compete effectively in the future.

IBM's cash flow in 1973 at $3.3 billion seems overpowering relative to its nearest competitor, Honeywell, Inc., with cash flow in 1973 of only $367 million.

Further, IBM held cash and equivalents at yearend 1973 of $3.3 billion, excluding $496 million in securities held for repayment of long-term debt.

In contrast, a number of IBM's general purpose systems competitors are burdened by relatively high debt levels.

The ability of IBM's competitors to raise outside capital is equally uninspiring for many of the reasons that have already been mentioned.

Also, excluding Burroughs, price-earnings ratios are relatively low: and again, excluding Burroughs, the ratio of common stock price to book value indicates that any new common stock offerings could dilute current stockholders' equity at a number of companies in the industry.

The future availability of external financing to computer systems manufacturers must also be viewed in the context of the history of the industry.

Through the decade of the 1960's, the mystique of the computer and the hypnotic influence of possibly approaching IBM's profitability attracted considerable external capital into the industry.

The myth that many companies would be able to achieve rapid growth and high profitability in the computer systems market has been shattered by the reality of the economics of the industry.

All of the previous financial considerations indicate that the industry could, and perhaps will, become even more highly concentrated than it is today if capital remains a major barrier to entry.

The history of independent peripheral equipment manufacturers' attempt to penetrate the general purpose market further illustrates the extent to which capital acts as an effective barrier to entry into the industry and the dynamics of the interaction.

In the late 1960's, independent manufacturers began to address the end-user market directly, with particular emphasis on the IBM rental base of peripherals attached to the IBM System 360 family.

The development of the end-user market for peripherals was the result of a number of factors: The potential market was large, particularly among IBM systems users; the economies of scale of product development and manufacturing were not significant barriers to entry: technological progress in peripherals had been slow, perhaps because IBM never had to compete on a peripheral subsystems level; profit margins were excellent: and peripherals were an increasing portion of the dollar value of a total computer system.

One of the major barriers to entry into the general purpose computer market, software compatibility with IBM, was avoided by making the independent peripherals fully compatible with IBM software and systems.

And the other major barrier to entry, capital, was reduced significantly, in part by investment enthusiasm for young technology companies in the late 1960's, but more importantly by the fact that an independent peripheral equipment manufacturer could address one market—for example, the digital tape drive market—and was not forced to develop an entire computer systems family.

By 1970, the success of Telex and the availability of initial capital had attracted a number of independent competitors into the industry.

During 1970, shipments of independent peripheral subsystems manufacturers increased sharply. Plug compatible manufacturers were achieving what IBM's systems competition had failed to do: They were providing some real competition.

Then, after careful study, IBM began to react; or overreact, depending upon one's perspective.

Despite the sharp financial setback of the peripheral subsystems manufacturers as the result of IBM's actions, some companies, through superior product lines, strong management, or simply luck, were not forced to drastically cut back product development and end-user marketing programs, and were continuing to enjoy strong customer response for their products.

But there was one missing ingredient: New capital was no longer available. IBM's actions served notice to Wall Street that competition on a peripheral subsystem level had little chance for success, and Wall Street listened.

IBM's promise of doom had the effect of a self-fulfilling prophecy.

Without the ability to raise capital, the outlook for end-user independent peripheral equipment manufacturers was bleak through 1972 and 1973. Then, in September 1973, the antitrust suit filed by Telex against IBM was decided in favor of Telex.

A number of the business practices adopted by IBM to contain the penetration of the IBM peripheral subsystems market were found to be in violation of section 2 of the Sherman Act.

Judge Christensen's decision in *Telex v. IBM* seemed to represent a new lease on life for the independent peripheral subsystems manufacturers.

The decision recognized peripheral subsystems as individual and distinct submarkets, and it recognized IBM's monopoly power in those submarkets, while providing a meaningful damage award.

Yet, following a very brief period of investment interest immediately after the surprise decision, Wall Street again turned a cold shoulder toward peripheral manufacturers.

The stated reasons for the lack of investment interest were mixed. And all of the reservations were valid, especially when combined with the most important consideration: Where are the peripheral subsystems manufacturers going to get the capital necessary to regain their previous position in the industry?

The immediate impact on the general purpose computer end-user of the initial success of plug-compatible peripheral manufacturers was significant.

For the first time, IBM computer users enjoyed a choice of equipment vendors for peripherals to be used with their systems and were able to realize meaningful reductions in total data processing expenses and improved systems performance by acquiring independent equipment.

And technological progress was accelerated by IBM's attempts to match and surpass superior competitive equipment, which provided additional benefit to the computer user.

IBM's systems competitors also benefited from the availability of superior products from independent sources which allowed them to concentrate their limited resources on central processing unit and software development.

The future contribution of a healthy computer peripheral equipment industry could have been even more dramatic. The ability to enter the industry with a single product line raised the possibility of expanding that line to include additional peripheral products, and, eventually, a central processing unit and a total general purpose computer system.

But that potential will never be realized because the capital necessary is simply not available today even if a company demonstrates that it has a superior product, capable management, and current profitability.

The capital barrier to entry combined with IBM's practice of marketing a total bundled computer system family gives IBM a high degree of control over the general purpose computer market, if not absolute control.

The ability of IBM to shift profitability from peripheral subsystems to central processing units and back again, depending upon the competitive realities of the market at the time, makes it almost impossible to compete on any level but on a total systems level, where the capital barrier to entry has proven to be almost prohibitive.

Profitability can also be shifted among the various peripheral subsystems, between the central processing unit and the operating system, and from one end of the computer systems family to another, if effective competition enters the market in any of those areas.

IBM has the added advantage over potential competition of controlling interface standards and new medial standards in the industry; of being able to deny field service support; of controlling the development of the operating system; and of possessing the only truly accurate data in the industry about market size and product profitability.

IBM's ability to orchestrate relative profitability and its many other advantages over competition would not be so important if the industry giant did not fully utilize all of those facilities in its competitive battle with the plug compatible peripheral subsystems manufacturers.

Profitability was shifted; interface information remains a closely guarded secret at IBM; media standards are changed, but the new de facto standard is not immediately released to the industry; field service support is occasionally denied to IBM systems with non-IBM equipment attached; changes in IBM's operating systems have severely disrupted a competitor's business; and the lack of accurate industry data has hampered competition.

The effect of IBM's competitive response to the initial success of subsystems manufacturers has been to warn Wall Street that competi-

tion on any level except on a total integrated systems level had no chance of success.

And, the warning was not a subtle hint. Major financial institutions have suffered, or stand to suffer, large financial losses because of the experience, including Bank of America because of its heavy commitment to Memorex; Continental Illinois National Bank, Telex's lead bank; and Metropolitan Life Insurance Co., because of its equity investment in Telex.

In the context of the disappointing performance of IBM's general purpose systems competitors and the harsh lesson of the peripheral subsystems manufacturers, it is not surprising that the flow of new capital into the computer industry has all but stopped.

My contacts with major financial institutions today indicate that they have no interest in investing in any peripheral subsystems manufacturers that are competing with IBM in the end-user market, and they have limited interest in investing in companies that are competing with IBM on a general purpose systems level.

Since capital is so critical to success in the industry it can only mean that competition in the industry will decline even further in the future.

Should the computer industry be restructured? The answer to that question seems simple. A competitive computer industry is vital to our national defense and to our continued economic and technological development.

And today, the industry is not only highly concentrated, but the present structure of the industry suggest that there will be even less competition in the future.

IBM would have us believe that there is no general purpose computer systems market, that there is only a total data processing market and that IBM's share is relatively small.

IBM's definition of the market is similar to suggesting that there is no domestic automobile market; that there is only a transportation market and that trains, buses, planes, taxicabs, and roller skates should all be included in the market.

IBM's broad definition of the data processing market is similar to my transportation industry analogy, but even that comparison does not fully describe the nature of the industry.

Data processing is much more basic and, because it is so basic, control of the largest market within the broadly defined data processing industry also grants effective control over technology in many areas that are critical to the future of this country.

But isn't technological progress best served by having one giant company control new product development, especially when that company spends in excess of $700 million annually for research and development?

Unfortunately, the present structure of the computer industry retards technological progress. IBM's marketing strategy is to introduce new products when competitive pressure within the industry demands advanced products.

In the absence of competition the rental-base nature of the industry makes it more attractive for IBM to keep installed products out in the field for as long as economically possible.

Consequently, IBM seldom takes the lead in new technological developments in the industry, except where there is no existing base of product.

Although the answer to the question of whether the industry should be restructured seems simple, the question of how the industry should be restructured is extremely complex, in part because it has been structured to resemble a monolithic industry.

My remarks have focused primarily on the rental-base nature of the computer market and on IBM's equipment financing business because they are key elements in IBM's dominance of the general purpose computer market; and they must be addressed in any restructuring plan.

Any future restructuring plan of the industry should also recognize that IBM's data processing operations are actually the sum of a number of businesses, including the development, production, and marketing of central processing units, operating systems, applications programs, and numerous peripheral subsystems; and it is also in the business of providing a number of services such as field maintenance, education and systems engineering, as well as lease financing.

Any one of those businesses could potentially be established as separate and independent competitive entities, significantly increasing overall competition within the industry.

Thank you.

[Mr. Collins' prepared statement appears as exhibit 1 at the end of his oral testimony.]

Senator HART. Thank you very much, sir, for an excellent statement. I want to ask just one question to underscore a point. The staff of the committee, I'm sure, will have many questions.

As I understand from the thrust of your statement, you are suggesting that until a company reaches a certain size, the more success it has, the greater will be its losses just because of the leasing nature of the business.

Mr. COLLINS. Yes, Senator; absolutely so.

Senator HART. What is the size necessary, in your judgment, for this trend of the more you ship the greater your lossage to change?

Mr. COLLINS. In terms of the break-even level, if we're addressing the market on a total computer systems level, that break-even point has been estimated at about 10 percent of the total market.

It's probably slightly less, but we don't have these numbers from the industry to really come up with exactly what that number is.

Now, that, Senator, is break-even level on a total systems level. The point where losses reach a peak is probably somewhere at the midpoint of that cycle; probably about 5 years, although, again, it's a rough estimate.

If it takes 10 years to break even, then it's probably in the 5th year that losses peak out.

And as a percent, I would guess it would be about 5 percent of the market.

Now, Senator, could I qualify that a bit? That's on a total computer systems level. Another point I was trying to make is that if a company can enter on a peripheral subsystems level, which is a much smaller market, that break-even level is reached much more quickly—even though it is a rental-base market—perhaps in 3 or 4 years.

So, the ease of entry, if you can address the market on a peripheral subsystems level, is considerably greater than it is on a total bundled systems level.

Senator HART. Mr. Nash?

Mr. NASH. Why is it, Mr. Collins, that the structure of the industry seems to be essentially one of a total systems basis?

Mr. COLLINS. Mr. Nash, there's a number of reasons for that. Number one, the industry itself is an outgrowth of the tabulating machine market of the 1940's and 1950's and tabulating machines were also marketed on a rental basis and on a total systems basis.

Number two, I should think it would seem obvious. It creates a major barrier to entry into the industry which creates a very comfortable environment for IBM.

Perhaps a third reason might be mentioned. In the initial growth of the industry the central processing unit, itself, was a very large portion of the total system.

That is less true today and will be even less true in the future.

Mr. NASH. If I understand your response to Senator Hart a moment ago—and correct me if I am wrong—you made the point that in your judgment if the industry were not structured on a total systems basis, then the barriers to entry would be less because the capital requirements would be less?

Mr. COLLINS. Absolutely.

Mr. NASH. In terms of inherent economies of scale, in your judgment, must the industry continue to be structured the way it is or would it be feasible for it to be structured on a nonsystems basis?

Mr. COLLINS. I believe it would be very feasible to structure it on a nonsystems basis. In terms of economies of scale, in each of the individual areas—in central processing units, operating systems, in each of the various peripheral subsystems, in applications software—there are different economies of scale.

The largest economy of scale is probably in the operating system. because once that's developed then the cost of producing the next copy is simply the cost of punching new cards.

So there are tremendous economies of scale in operating systems. Then again, on a peripheral subsystems level, there are not very large economies of scale to manufacturing and for electronic products, such as central processing units and controllers, there are not large economies of scale to manufacturing.

Consequently, there are various economies of scale to the industry, if it's segmented.

Mr. NASH. You have underscored the point that because of the structure, the largest single barrier to entry is the massive capital required.

You attribute the capital requirement to primarily the leasing nature of the business. Is that right?

Mr. COLLINS. Yes, Mr. Nash; plus IBM's practices make that capital requirement far more significant than, in fact, it should be.

I'd also like to go back a little bit and suggest that there is another principal barrier—that systems lock—which encompass a lot of those things that previous testimony has addressed—the very high level of support that IBM gives to its customers plus the fact that IBM customers are in a sense locked into IBM software, such that they cannot easily change manufacturers.

I've taken all of those things and put them together and called that a "systems lock" so that I could focus on that other barrier to entry which I see operating every day—and that's the capital barrier.

Mr. NASH. Could you enlighten us as to why the nature of the computer industry business seems to be one of leasing rather than outright sale?

Mr. COLLINS. It seems like that comes back to a previous question. There are many reasons for IBM shipping equipment on a rental basis or on a lease basis; many very positive reasons.

First it allows equipment to be shipped to customers that could not normally afford the equipment. If it becomes a question of buying a million dollar computer or renting it at so much per month, the million dollar buy decision is a very difficult capital decision for most firms, while rental on a month-to-month basis is an operating decision.

There are other reasons why customers rent computer equipment. Another reason is that they're afraid to get locked into current technology; that technology has been moving along fast enough in the industry and customers are reluctant to commit to a piece of equipment by purchasing because of the risk of having that equipment obsoleted in some meaningful time frame.

And that, of course, is the type of reasoning on the part of the users that IBM very much encourages.

I think that major reason for a rental industry is obvious from the structure of the industry.

It provides a major barrier to entry into the industry. And I can go back and recite chapter and verse. Control Data, initially, successfully entered the industry by concentrating on very large scientific computers—a market where equipment is sold outright.

Scientific Data Systems entered the market by concentrating on medium-scale scientific systems, a market where equipment is sold outright.

I've left out the whole minicomputer industry from my analysis. I've focused on general purpose systems manufacturers.

The minicomputer industry has grown very significantly, and it's very healthy today because it's an outright sale industry. Every time we run into the problem of addressing a rental base market, such as the general purpose systems market, competition has had extreme difficulty entering the industry.

Mr. NASH. On the other hand, you would agree, would you not, that it would be detrimental to the user to require computers to be sold rather than providing them on rental or lease terms?

Mr. COLLINS. No; not necessarily. And the question does pose a problem, because we run into the old economist ploy of other things remaining equal.

It's hard to hold all other things equal. There would be tremendous advantages to requiring the manufacturer to sell computer equipment outright to the customer and to separating that manufacturing marketing function from the financial function.

It would significantly accelerate technological progress in the industry. It would lower a major barrier to entry. It also would have some disadvantages, as you suggest. It would make it more difficult to put computer equipment in the hands of those customers who are reluctant to make the purchase decision.

But within that environment a whole new leasing industry would probably evolve that would assume the risk of financing short-term leases within the industry.

Mr. CHUMBRIS. Would you yield for a moment, Mr. Nash? You said the prospective person would be reluctant. Wouldn't he have an inability as well as reluctance?

I think you mentioned that in respect to if he had to pay cash rather than go on a rental basis.

Mr. COLLINS. It's a question of capital commitment to a corporation. A computer is a piece of capital equipment and can be judged just as any other piece of capital equipment is judged in the total financing plans of a corporation—whether it be a new piece of production machinery—and can be considered in the context of all of those available means of financing the acquisition of a new piece of capital equipment—new equity offering, new debt offering, et cetera.

Mr. NASH. Mr. Collins, to alleviate the financing burden on a user would it be feasible to create a large new industry; say a computer leasing industry or a GMAC-type entity for computer leasing?

Mr. COLLINS. Mr. Nash, as a generality, yes; it is feasible and it is reasonable. In fact, through the whole third generation of computer systems we did have a reasonable leasing industry develop which was, in part, developed on some very bad equipment life assumptions; but, nevertheless, an industry did begin to develop.

Whether or not we could set up a GMAC-type of operation sounds feasible; but again, it could not be done entirely in the current context of the industry.

IBM has too large a share of the market. IBM has too much control over technology and over prices in the industry that if we simply set up a GMAC, that GMAC would want to purchase almost all IBM central processing units; although, it would purchase many independent peripheral equipment subsystems.

Mr. NASH. Does that mean creating an effective competitive atmosphere in the industry that requires a sort of multifaceted approach?

Mr. COLLINS. Absolutely.

Mr. NASH. You noted in your statement that IBM has a cash position of roughly $3.3 billion.

I was wondering whether it was unique or commonplace for large corporations to have such a cash position.

Mr. COLLINS. It is extremely unusual for corporations to have a cash position that large. And it's unusual in the context of IBM for it's cash to be quite that much of total current assets and total corporation assets.

There are probably a number of reasons.

No. 1, IBM was restricted to some degree as far as the amount that they could increase dividends over the last year or 2—which built up that cash position somewhat.

Also, the sales to lease mix on shipments of some models of System 370 seem to be higher than what IBM expected.

So they got that cash initially in terms of profits and cash flow rather than deferring it until later years. And I can't help suspect that IBM doesn't want a large cash position now because of some of the things that are happening on an antitrust front.

Mr. NASH. What are the competitive ramifications of such a large, $3.3 billion, cash position; if there are any?

Mr. COLLINS. Well, in terms of capital and cash flow and the ability to raise external financing, that $3.3 billion is extremely important

along with the cash flow of $3.3 billion in 1973, because it suggests that IBM could go into a new equipment cycle; for example, a future system which could obsolete a great deal of their current lease base of 370's and have the cash to support that capital commitment to the new rental base.

Whereas, competitors do not have that flexibility. Consequently, it would prematurely obsolete current systems competitors' equipment at a time when they are not in a position to commit the capital to building and expanding a new lease mix.

Mr. NASH. What does IBM do with the $3.3 billion in cash? Do they deposit it around the country in different banks, invest in securities, or what?

Mr. COLLINS. I believe it is primarily invested in short-term Treasury bills. There is a portion of that cash in longer term notes that are kept below the current asset line and called securities for repayment of long-term debt.

Mr. NASH. I take it their long-term debt position is considerably less than their cash position. Is that right?

Mr. COLLINS. Absolutely; and that is all foreign debt, if I am not mistaken.

Mr. NASH. You made the point several times that the capital required for entering into an increased market share in this business is virtually impossible to acquire, for a variety of reasons.

In your judgment, but for the omnipresence of IBM's market position, would debt and equity capital be available to this industry?

Mr. COLLINS. Oh, absolutely, Mr. Nash. This is the most exciting industry on the U.S. business scene today. It is a technology-based industry. It is growing rapidly.

The markets that are out there for the technology of the data processing industry are truly exciting, and capital would be committed at a very high level.

The late 1960's was certainly an exaggerated period, but it reflected the enthusiasm of investors to participate in some of the exciting technological things that would be happening in this industry.

Part of my point is that we have subsequently learned it requires more than just a good product, and more than just a capable management, and more than an effective sales and field service organization to succeed in this industry.

Mr. NASH. In your statement you said:

> IBM's marketing strategy is to introduce new products when competitive pressure within the industry demands advanced products.
>
> In the absence of competition the rental-based nature of the industry makes it more attractive to IBM to keep installed products out in the field for as long as economically possible.

Could you elaborate on that insofar as this type of decision relates to the rental-based nature of the industry?

Mr. COLLINS. Certainly.

It may be possible to go all the way back to the beginning of the industry, although I am not absolutely sure.

It was Univac that shipped the first commercial computer system, at a time when Univac had a relatively small portion of the tabulating machine market and IBM had the major portion of the tabulating machine market.

IBM seemed to be initially reluctant to go into the computer systems industry, and perhaps one of the reasons was the very large lease-base of IBM tabulating machine equipment that would have been obsoleted if, indeed, the computer system began to replace tabulating machine equipment at those data processing installations.

Another illustration is the example of peripheral subsystems, in tape and in printer, through the decade of the 1960's. Technological progress had been very slow, in part because it was in IBM's best interest to keep that equipment, some of which was fully depreciated equipment, out in the field generating revenues and profits on an annual basis, and only obsoleted that equipment when forced to by competition.

I think perhaps an example that is a little bit more current relates to an independent peripheral subsystems manufacturer, Storage Technology, the independent leader in tape drive subsystems today.

In 1973 Storage Technology announced that they would have a tape drive with a higher packing density than previous tape drives in the industry.

The previous standard had been 800 and 1,600 bits of data per inch of tape. IBM subsequently announced a new tape drive themselves, with 6,250 bits per inch of tape.

Now, I can't say for sure whether or not IBM would have introduced that new device if it was not for competition, if it was not for Storage Technology, but because of the rental-based market there seems to be little reason for IBM to introduce a higher density tape that allows their computer users to store as much information on less tape and use less equipment than he is currently using.

Mr. Nash. One defense of the present industry structure, we have heard, is that users get good service, good quality products, at low prices.

From your perspective I am obtaining the impression that you believe—and correct me if my impression is wrong—that the industry structure has resulted in utilization of less than current technology, and its prices are higher than current technology would allow. Is that a fair understanding?

Mr. Collins. That is a fair understanding of my statement. I am suggesting that may be more true in the future because a great deal of technological progress came from the semiconductor industry and from competitors within the industry that are no longer in the industry or are on their way out of the industry, so that the competitive structure in the future looks like it will promote competition far less, which suggests to me that technological progress will slow down in the future.

Mr. Nash. In evaluating whether a positive or negative effect on the stock market or stock market values of computer companies would result from a restructuring of IBM, do you believe it is appropriate to analyze the present market values of the computer companies and ascribe different value to them which would exist, but for the present industry structure?

By that I mean: Your table indicates that IBM has a price per earnings ratio of roughly 18, but Burroughs and other computer companies, I think, had multiples of between 6 and 10. Were those low multiples because of inferior management, inferior products, or because of industry structure?

Mr. COLLINS. I believe it is because of industry structure, and because of the performance of those companies, on a revenue and profit level over the last 10 years, or over the last 5 years, or over the last 15 years that they have been in the industry rather than in inferior management.

One of the companies that dropped out of the computer systems market was General Electric, which is typically looked upon as one of the models of a well-managed company.

And even among the companies in the industry today, Honeywell has a very successful business in residential controls, in industrial controls, and in a number of other areas that suggest that that management is, indeed, capable.

Yet, Honeywell's success in the computer systems industry is somewhat questionable. I think you can also say the same thing about Sperry Rand.

Sperry Rand's other divisions are, on balance, very successful divisions, very profitable divisions, among the most profitable in their respective market areas.

Mr. CHUMBRIS. Would counsel yield on this point?

You mentioned the fact that General Electric, one of the great companies in America, got out of the computer business.

Then, I think, testimony yesterday or the day before indicated that there were a few other major companies who were in the computer business and they got out of it also.

But we have had instances where Kaiser Aluminum tried to get into the automobile industry, or some other giant corporation, let's say of the first 500, tried to get into another field but found it wasn't their field so they moved out.

So examples of giant corporations trying to get into a new industry don't always necessarily work. I think that is one of the good things about the American industry system, that if you are a specialist and you know how to run your particular business, you will be top man.

You can take General Motors, which is the No. 1 corporation, I guess, and if it tried to get into other fields, maybe it would find that it would have the same difficulties as some of these large corporations who have tried to get into the computer industry.

Mr. COLLINS. I agree absolutely with your statement.

I might make one distinction, and that is that Kaiser tried to get into the automobile industry not into the transportation industry, which is a closer analogy.

And General Motors might try to get into the data processing industry, which is that general name for the industry, as opposed to some individual market within that industry, one specific market like systems or like a peripheral subsystems or like applications programs or like terminal subsystems.

Those are closer analogies to the aluminum analogy.

Mr. CHUMBRIS. I am glad you brought out a different analogy, because that is one that came close to us. We had some hearings concerning the automobile industry on S. 1117 this year, and that was brought out at that time.

Mr. COLLINS. Thank you.

Mr. NASH. Mr. Collins, in your judgment what type of minimal steps do you believe are required, if any, to make the computer industry more competitive?

Mr. COLLINS. Mr. Nash, I have troubled with that question for a long time, and I have no specific answers. I think a major first step is recognizing that the industry is the sum of a number of markets and a number of submarkets, and of allowing the antitrust laws to work in order to address the industry on that basis.

And if they prove ineffective, then take positive steps to reorganize the industry to establish separate entities that are addressing those individual separate businesses.

I believe your suggestion about a GMAC-type of operation, or about requiring IBM to sell systems outright to customers, is a good first pass at possibly solving one of the problems of the industry.

But my difficulty is that there are many problems and they are very much interrelated, and it is difficult to say we should do this and that will solve all of our problems.

Perhaps, if some definitive plan is organized, it should be done in steps to allow the industry to adjust to those various steps as we move along to establish, eventually, a competitive industry.

Mr. CHUMBRIS. If counsel will yield? Again we bring up the point that has troubled us in our other hearings that we have held on this particular bill.

When you were talking about the GMAC approach, I gather from your testimony this is speculation as to whether that would be a good approach or not a good approach.

As a matter of fact, most of the testimony we have received so far are people speculating as to what would happen if the bill becomes law, or speculation if the court should take an approach of divestiture.

Indications are that, in the early part of the data processing industry, if it had not been for the leasing program, that many of the people would never have entered into the business.

Many of them were highly successful, especially in the earlier part. Then when you got into the question of whether they should lease or buy, that is when some of the problems arose.

I think, as we go along, we will have to delve with more testimony, more facts and figures, statistics, as to the approach of whether a person should be permitted to buy or to rent.

I think you pointed out it might be bad if there were a law forcing you to be forced to buy it; is that right?

Mr. COLLINS. Yes; now, I was talking not from the point of view of the end user being forced to buy. I was talking from the point of view of suggesting that perhaps it would be good for the industry if IBM was forced to sell.

Then to the user, that becomes a decision like any other capital equipment decision. If he can lease it from a third party then he will do that. If he wants to pay cash for it he can do that.

Mr. CHUMBRIS. I was leading into another parallel that we held hearings on in the middle 1960's. We were discussing the automobile industry at that time, and the issue there was "make or buy."

In other words, the automobile manufacturer would determine whether they would make all their parts that go into an automobile or buy some from another company and make the rest of the car.

I don't remember the exact number, but it seems to me there were 50,000 corporations in the United States that made parts that went into the automobile; and the automobile manufacturer, rather than make them, bought from these 50,000 manufacturers. This might be a parallel to the unlimited number of small people who are in this data processing, whether it is in software or peripherals, and who are living off of this industry, may be because of the procedures that have been in effect since the industry started in 1955.

I don't know whether that is a good parallel. I am just throwing it out as an idea. As we continue with our hearing, some witnesses may touch on that point.

But from what I gather, especially in the Washington area, every day you will read in the financial columns some type of a data processing company, many of them very small, which is making a living off of this industry.

Washington is loaded with them, because of the fact the Federal Government is here and many of the head offices of corporations are located in the Washington area.

Mr. COLLINS. Could I make a couple of comments?

Mr. CHUMBRIS. Yes.

Mr. COLLINS. No. 1: One of the major problems that we have is the lack of good accurate data about this industry; and No. 2: yes; there are many small companies participating in this industry, one- and two-man programer shops and systems shops.

My suggestion is that if this industry is put on a competitive basis there will be far far more of those companies, some of which will be of reasonable size, capable of tapping the public capital markets and growing into very strong and reasonable competitors in this industry.

And that is something that is extremely difficult today.

Mr. NASH. I'd like to ask about the market values of the various companies like Honeywell and so forth. If a restructuring of the computer industries would take place, do you see positive or negative impacts on the market values of computer industry companies?

Mr. COLLINS. Mr. Nash, that's an almost impossible question to answer unless some definitive restructuring plan is suggested.

Mr. NASH. Generalizing that the Justice Department's current thinking, as I know it, of establishing IBM's general purposes to assist in these operations, there were a number of independent conclusions.

Mr. COLLINS. The Justice Department plan suggests to me that the current competitors are going to have a difficult time because IBM would no longer be restricted in it's market share and could aggressively go after the other market shares of the others in the industry. I think that plan has ominous implications for the rest of the general purchase systems manufacturers. That, of course, is one possibility. There are many other possibilities.

Mr. NASH. What about the effect of the value of the IBM shareholder under this hypothetical plan?

Mr. COLLINS. Could I first go back to one previous point before moving on to that?

Mr. NASH. Sure.

Mr. COLLINS. Many of the things that are happening today, simply raising the question of a possible restructuring of the industry as a result of the Telex litigation, the Justice Department litigation, these hearings, are counterproductive from a capital point of view.

They are making that potential investor step away and say he will wait to see what happens; and the longer it takes for something to happen the further behind those companies are going to fall because capital is simply not available.

The second part of your question was what would be the impact on IBM's stockholders of any restructuring. Again, there are so many possibilities it is difficult to determine.

I would say, in general, that it would be a positive impact; that the sum of the parts would be valued in excess of what the whole is valued today.

Mr. NASH. I have no further questions, Mr. Chairman.

Senator HART. Mr. Chumbris?

Mr. CHUMBRIS. Thank you, Mr. Chairman. I've had my say on this particular point. Dr. Mike Granfield, the minority economist, has some questions he would like to ask.

Senator HART. Mr. Granfield?

Mr. GRANFIELD. Thank you, Mr. Chairman. I'm sure my questions will strike you extremely naive and uninformed. I readily admit that I'm an economist and we all admit we are relatively naive and uninformed.

Let me deal with this problem of capital entry. I'd like to separate out, perhaps in the discussion here, some of the two components of that.

When you talk about a capital barrier entry do you mean the absolute amount of capital that has to be raised?

Mr. COLLINS. Yes; I do.

Mr. GRANFIELD. To an economist this is a very interesting notion, because it is our feeling that if a firm is earning a competitive rate of return it can attract sufficient capital to expand and prosper. Would you agree with that?

Mr. COLLINS. Yes; I would.

Mr. GRANFIELD. Would you then agree with the real problem here that if any firm has a problem of raising capital it must mean the investing public perceives it will not earn a competitive rate of return relative to investments?

Mr. COLLINS. That is, in general, true.

Mr. GRANFIELD. In general, true, you say.

Mr. COLLINS. Yes. Expectations must enter that equation.

Mr. GRANFIELD. Absolutely. So the real problem here is the barriers to enry are not facing that because of the size of the capital barrier but because the investing public perceives they will not earn a competitive rate of return.

Mr. COLLINS. It's a combination of the two things. The investor doesn't know whether or not that company in the future will be able to realize a competitive rate of return.

If you build and ship $100 million worth of equipment, you can tell immediately. You know what your production costs are. You know what your marketing costs are. You can tell whether or not you were realizing a competitive rate of return.

In a rental-based market it may be 5 or 6 years before you know whether or not that return will be a reasonable return.

Mr. GRANFIELD. You're telling me your risk is higher, the longer expectation of a rate of return or the longer investment arising because the uncertainties involve a good deal of risk.

Mr. COLLINS. Absolutely.

Mr. GRANFIELD. Again we come back to the risking investment at a higher rate of return the investor will demand before he invests his funds.

You're telling me the computer business is not the size of the capital barrier?

It's really inherent, you're telling me, because of the technological structure of the industry that perhaps there's a high risk involved so that the investor will demand a higher nominal return than he would in an industry in which the technology—in any case, you can start a business in a short amount of time.

Mr. COLLINS. It is also the absolute size of that barrier.

Mr. GRANFIELD. Could you please explain that?

Mr. COLLINS. I can explain it in the sense that if we're addressing the industry as a total computer system's industry, that means that an extremely large amount of capital must be committed to enter that industry.

If we are addressing the industry as the sum of individual submarkets and individual products, a considerably lower amount of capital must be raised, then, to enter that industry.

So you're absolutely right. That risk element is extremely important, but the absolute size of that barrier is also an extremely significant factor.

Mr. GRANFIELD. Are you claiming that the only way to successfully enter this industry is on a total systems basis?

Mr. COLLINS. I'm suggesting that IBM's actions, in the case of the plug-compatible peripheral subsystems manufacturers, said exactly that; yes.

Wall Street seems to be stuck with the paradox of if I invest in a company in the industry and it is successful, then IBM will take steps to cover that particular submarket or that particular flank.

If, on the other hand, the company is not successful, I had no reason investing in it in the beginning.

Mr. GRANFIELD. Are all the plug compatibles now at a dreary state in terms of rate of return? Let me be more specific. I have a list here of the CIA members.

Unfortunately all I have is their revenues and I note that some have actually experienced decrease in total sales for 1970 to 1973 and some have been flat.

Despite the fact that some are experiencing increases in sales, are all of them experiencing low earnings performance?

Mr. COLLINS. No; not necessarily. The principal and major factors in the industry initially—the Telex Corp., Memorex, and California Computer Products—are having varying degrees of problems.

Telex took a writeoff in its fiscal year ended March 31, 1974, that reduced its stockholders equity to effectively zero. Telex is effectively out of the business.

Mr. GRANFIELD. Could it be Telex lost its business to other plug compatibles rather than IBM? I mean, to more successful plug-compatible firms?

Mr. COLLINS. No. I believe that is a consideration, but I do not believe that's true, and I believe the evidence suggests that it isn't true.

Memorex, of course, also has extreme difficulties from a capital point of view. California Computer Products is an interesting case because the company saw what was coming and redirected its disk drive efforts to supplying Univac, supplying Burroughs, and supplying General Automation; and the company will record probably a very successful year in the year ending June 30, 1974.

They will probably earn about $1.60 a share on revenues of $125 million, and their common stock is selling at about $8 a share, and they cannot raise permanent capital at reasonable terms.

Mr. GRANFIELD. That's the key thing: reasonable terms.

Mr. COLLINS. Yes.

Mr. GRANFIELD. They can raise the capital. They can raise the funds with a bond issue, but the yield on that might be prohibitive.

Mr. COLLINS. Sure.

Mr. GRANFIELD. I want to make that point quite clear. They can raise the capital.

Mr. COLLINS. Well, yes, it's true; but not necessarily true. The cost of raising that capital may be counterproductive. It may not be worth it.

In fact, that's the reality of the industry today. If, in fact, to get that long-term debt, the company has to put equity sweeteners in there in terms of common stock and such that through committing that additional capital over the 2 years, they'll end up being at a place in current stockholder benefit below where they might be now.

Companies are in the position now where they're saying that because of the cost of capital, it's not even worth it to expand. We may as well stay where we are.

Mr. GRANFIELD. I understand many firms today are facing that problem. It's not unique to plug compatibles. Many firms given the prime rate, the cost of floating a bond issue, can't afford to expand at this point of time.

Mr. COLLINS. That is absolutely true, and I addressed that question in my statement to suggest that that is true as a generality, but in terms of the general purpose computer industry, that there are unique considerations.

Mr. GRANFIELD. Because they are more competitive than other industries?

Mr. COLLINS. No; not because they are more competitive. Because that capital barrier, No. 1, is so enormous; No. 2, IBM has suggested by its past practices that competition on anything but a total systems basis is impossible; and No. 3, because investors have already lost tremendous amounts of money in this industry because they did not understand the nuances of the industry. They understand now and they're staying away.

Mr. GRANFIELD. You can perhaps view this as there might be excesses in the industry. I understand other industries are experiencing severe growing pains. Is that your impression?

Mr. COLLINS. Yes; that's true. It happens often.

Mr. GRANFIELD. It happens often that we find excess energy and the profit isn't there because of vigorous competitive pressures.

Mr. COLLINS. Absolutely.

Mr. GRANFIELD. It doesn't imply anything wicked or evil going on. Is that not correct?

Mr. COLLINS. Sure. That's absolutely true. I'm suggesting this is different.

Mr. GRANFIELD. It may be different.

Mr. COLLINS. It maye be different.

Mr. GRANFIELD. That's a legal question that has not been litigated completely. Is that not correct?

Mr. COLLINS. Well, I——

Mr. GRANFIELD. Certainly, that remains unanswered.

Mr. COLLINS [continuing]. I'm attempting to avoid that legal question.

Mr. GRANFIELD. Let's deal with the financial economic considerations. That question remains unanswered.

Mr. COLLINS. I'm sorry. Could you repeat that?

Mr. GRANFIELD. It's not clear. Is it clear as to why? It might be because certain answers of IBM; it might be because of competitive pressures leading out to——

Mr. COLLINS. It's all of those things. You're absolutely correct. But as I, on a day-to-day basis, talk to people that are potential investors in this industry and we discuss the reasons why they may or may not make an investment in the industry, there are two reasons that come out and come out very loud and clear.

One is the systems lock; the other is the capital barrier; and the capital barrier would not be so important if IBM did not take full advantage of it.

Mr. GRANFIELD. As I read my reports from Merrill Lynch and also Standard, I am fraught with great uncertainty with almost every major industry I would want to invest in.

I think about petroleum and the allegedly high profits. I don't know how long they're going to last. I now read in the Washington Post that there are excess supplies of petroleum available with the threat of price controls, et cetera.

I look at the automobile industry. It's related to the energy problem. That concerns me in terms of earning a normal rate of return.

I look at steel. They're doing very well now. Traditionally they don't. They only have a few good years of prosperity.

What I'm saying is the whole aura of investments today are fraught with great uncertainty, in part because of inflation, in part because they feel there's not sufficient capital available on cross industries.

You're saying this industry is more unique than that. But every industry spokesman says our industry has more profits than anybody else, and ultimately they turn to Washington for help.

Nonetheless, I see problems across the board because of capital crunch and constraints.

Mr. COLLINS. I agree with you completely. The capital market, in general, in this country, is in bad shape.

Mr. GRANFIELD. The money machines have slowed down.

Mr. COLLINS. Virtually to a halt in some particular areas.

Mr. GRANFIELD. Let me come to another problem here, and hopefully it will be related, at least in my vague mind, to this capital barrier problem.

IBM is a total system.

Mr. COLLINS. Total computer systems family.

Mr. GRANFIELD. Control data is basically the highest technology industry, scientifically based in computers. Is that correct?

Mr. COLLINS. Yes, that's the emphasis.

Mr. GRANFIELD. Is that what Burroughs is, too?

Mr. COLLINS. No. Burroughs has a product line that is somewhat similar in the breadth of that product line to the IBM product line.

However, Burroughs has picked out individual product lines, terminal subsystems, and business accounting machines markets where equipment could be sold outright, and they've also concentrated very heavily on one of their traditional markets and that's the banking market, again where a product could be sold outright.

Mr. GRANFIELD. NCR is where? Where are they now? Where are they concentrating their attentions?

Mr. COLLINS. Primarily on the lower end of that systems market.

Mr. GRANFIELD. Sperry Rand?

Mr. COLLINS. Sperry Rand. Almost across the board, with emphasis on the higher end.

Mr. GRANFIELD. Honeywell?

Mr. COLLINS. Honeywell, virtually across the board.

Mr. GRANFIELD. GE? Where were they?

Mr. COLLINS. GE concentrated on time sharing, a concept that later became generally accepted within the industry, but they did the pioneering in that effort.

The GE and Honeywell product line fit together such that if you did ask, or if you are going to ask, the Honeywell question, that's what gave Honeywell that full product line.

Mr. GRANFIELD. Where was GE? The kind of machine that was selling?

Mr. COLLINS. They were on the low end of the spectrum and on the very high end.

Mr. GRANFIELD. RCA?

Mr. COLLINS. RCA was very much medium-to-large systems.

Mr. GRANFIELD. Now, I'd like to review what you told me here. That was also my very naive impression. NCR is an area where they traditionally had some comparative advantage, or at least wanting to tie the computers in certain low-level machines. Is that not correct?

Mr. COLLINS. Yes, that's correct; in the sense they had that office equipment marketing organization.

Mr. GRANFIELD. Control data organized what I would regard as one of the finest teams of solid state physicists and electrical engineers available in the industry; is that not correct?

Mr. COLLINS. That's correct.

Mr. GRANFIELD. Were they not founded by a similar gentleman?

Mr. COLLINS. Yes.

Mr. GRANFIELD. GE went to the top end of the field because they received some governmental contracts in developing computers with respect to municipal guidance systems. Is that not correct?

Mr. COLLINS. I can't verify that. I will accept it.

Mr. GRANFIELD. Where they had some previous background. Without going into the other details of the firms, it seems to be that each one of these firms has entered the field where the fellow had a technological comparative advantage or at least could conceivably develop that.

Mr. COLLINS. That's correct.

Mr. Granfield. From what I understand IBM perceives the field as a much broader technologically-based field. In reading articles subsequently published by GE, IBM's great insight and genius allegedly was they saw this as a service-based industry; just as important as developing good hardware, developing personnel to show the customer how to effectively use his hardware.

It would seem to me that one interpretation of what's happening in this industry is that IBM's success is in part based upon their perception that this was a service; more important, a service-based industry than a technology-based industry; that it's important to have good hardware; it's even more important to have personnel needed to show the customer how to effectively use this hardware. And this is where they spend an amount of funds to develop what economists call "human capital."

In other words: In the computer industry you could develop physical capital, and very competent physical capital, but IBM developed physical capital as well as human capital; the human capital being their salesmen and technical staff to service their computers.

This is what has led to their success, as opposed to some of the other allegations made, and looking across the board here, each firm has attempted to enter the computer industry where it felt they had a technological, comparative advantage and simply ignored, relative to IBM, this other critical aspect of the industry. Do you have any comment on that naive interpretation?

Mr. Collins. Yes. My comment would primarily focus on the fact that, however well or less well, these companies understood the industry at the time they were addressing it—they realized that cost of entry was so huge that they had to focus on some aspect of the industry where they had a technical advantage, where they could sell equipment outright, where they didn't have to have an army of salesmen and of systems engineers and of support activities—in order to initially get into that market that that's the basis for these companies focusing on those individual markets.

IBM, on the other hand, had huge deferred profitability in its tabulating machine lease base and a marketing group established such that it was simply a natural extension of their dominance of that market that allowed them to absorb those initial front end costs, again the high cost of entry getting into the market.

The paradox is that if any one of those companies had attempted to address the general purpose systems market by building that extremely capable sales, field service, systems support activity, and shipping that product on a lease basis the losses would have been so huge that they could never raise that next level of financing that they needed in order to stay in the industry.

Mr. Granfield. That's because you would perceive they wouldn't be under a competitive rate of return. I don't know that they couldn't raise the capital. They were not effectively spending that capital as other alternative investments open to the investing public.

Mr. Collins. Let's take Control Data in the mid-1960's. The paradox is that the company was extremely successful in huge number crunches that they sold to the scientific market.

If they made the decision that the incremental $100 million worth of equipment that they were going to ship in that next year was going

to be into the general purpose market and they put together that entire support activity that was required and they shipped that equipment on a lease basis, my example in my statement shows the negative numbers that would have shown up.

The paradox is that if they would have made that decision they never would have gotten any more money to be able to pursue that activity; and indeed, it's questionable whether or not Control Data would have survived if they did not acquire Commercial Credit at the time that they did.

Mr. GRANFIELD. You have indicated, and we have heard this in previous testimony, that IBM only innovates when competitive pressures force them to. Yet it is my understanding that one reason General Electric and RCA dropped out of this industry is the rapid pace of technological change.

Let me explain my point. It may be a strange one but it says that if IBM had been allowed to pursue their normal pace of technological development, and these other firms are now trying to leap frog ahead in technology, that we would still see RCA and GE in this business.

Mr. COLLINS. Yes; I agree.

Mr. GRANFIELD What I'm saying is it is the competitive technique used by IBM's competitors that drove GE and RCA out of business, not IBM.

Mr. COLLINS. As a generality I agree. What we run into is a paradox of many, many paradoxes of a rental based market.

Yes, to a degree that was true. It was perhaps Burroughs innovating an increasing market share that led IBM to announce its System 370, which then in turn led RCA to drop out of the industry. But that does not negate the fact that given a less competitive environment in the industry, that the motivation of the leading rental based company to innovate will be significantly less.

Mr. GRANFIELD. Just one final point I would like to bring out. We have heard a lot about technological innovation.

To economists this has two sides: You must not only innovate but innovate a product that sells to the consumer at a reasonable price through a reasonable level of services for that price.

There are times when we innovated too quickly. One example I would bring out. No one would dispute that the latest Polaroid camera is a technological wonder which may yet undo the great previous miracle of the Polaroid Corp. Because from what I understand they brought that technological innovation onto the market too rapidly, and they are having tremendous service problems with that particular camera.

What I'm saying is that many industries are parallel to this. It's important to time that technological innovation to the point where it can be adequately, reasonably, and viably serviced, not where they can perform on 1 day a tremendous technological feat.

Service is the name of the game. We can see that happening in the automobile market. The automobile buying public has decided that gadgetry—the diminishing returns of gadgetry and increasing returns to reliability—I'm saying that is the critical decision that always has to be made.

The more technologically advanced the field, the more difficult and complex that decision becomes, so to fault a firm for not beating its

competitor to the market with what looks like a new improved product is a very difficult question because that product must also perform reliably.

I can think of no other area than in the computer area where these become more apparent. I have been with five different universities where we innovated new systems. I have gotten a peptic ulcer every time.

I was more than satisfied with my previous service. I know you ultimately have to innovate, but I felt every time the cost of that innovation to the use of myself was extremely high.

That's an uncalculated cost in man-hours and time that I put in and that happens with all end users. Those are the hidden costs of too rapid an innovation. If you want to comment, please do.

Mr. COLLINS. Just very briefly. Again, I agree that the service component is extremely important, but does that enter in all areas?

For example, didn't we, for many years, have to use a keypunch and a verifier for data entry, when finally they were combined into a buffered keypunch that saved that customer a heck of a lot of money.

Now that was a technological innovation that I believe did not come from IBM. I believe there is a pretty good reason why it didn't come from IBM, and the whole data entry market is similar to that.

I mentioned before my example of the 6250–BPI tape drive. You don't need a high level of service to implement something like that, but it could save the customer tremendous amounts of money.

Mr. GRANFIELD. Thank you very much.

Senator HART. Are there any other questions? Thank you very much for an interesting, as well as informative, discussion.

The Senate has scheduled consideration of a bill that came out of the Judiciary Committee. There is an amendment which I feel the bill requires. A notice has just been received that the bill is now open for amendments.

For this reason I must recess the hearing. Under the Senate order, debate on amendments is limited to 30 minutes.

Let's be optimistic and recess until noon.

[Whereupon, at 11:10 a.m., the subcommittee recessed, to reconvene at 12 noon this same day.]

[The following was received for the record:]

MATERIAL RELATING TO THE TESTIMONY OF EUGENE K. COLLINS

Exhibit 1.—Prepared Statement of Mr. Collins

PREPARED STATEMENT OF EUGENE K. COLLINS, DIRECTOR OF RESEARCH, EVANS & CO., NEW YORK, N.Y.

My name is Eugene K. Collins. My business address is 300 Park Avenue, New York, New York 10022. I am Director of Research and a security analyst specializing in the computer industry at Evans & Co., Inc., a New York Stock Exchange firm that is engaged in investment banking, investment research for financial institutions and brokerage. My undergraduate work was done in electrical engineering and economics and I studied investments and finance at the New York University, Graduate School of Business.

I have been a security analyst at New York Stock Exchange firms since 1965, initially following technology companies generally and aerospace and office equipment companies specifically. Since 1968, my analysical work has been almost exclusively in the computer industry, except for a brief period during 1971–1972. During that timeframe, I developed and published forecasts of the U.S.

economy and formulated overall investment strategy as Associate Director of Research for the New York institutional research operation of Black & Company.

My analytical work in the computer industry has focused primarily on IBM and on young technology companies that might be able to successfully penetrate the industry. My interest in young companies in the industry and in IBM are closely related disciplines since IBM *is* the computer industry and the business practices of IBM largely determine the economic structure of the industry.

I regularly advise companies in the industry on the subject of future financing plans and I successfully raised initial financing for a company in the industry. In 1968, I was instrumental in first introducing peripheral subsystems manufacturers to Wall Street and to financial institutions as potentially attractive investments in the industry; and have closely followed the rise and fall of those companies as meaningful competitors in the industry. I am generally regarded as Wall Street's resident expert on computer peripheral equipment manufacturers.

In my current capacity as a security analyst at Evans & Co., I act as a consultant to banks, insurance companies and mutual funds on the subject of investing in the computer industry; and I publish extensively on the industry and on individual companies in the industry. Many of my remarks today will reflect impressions that I have received through almost daily contact with major financial institutions over a period of six years.

My statement today will deal with:

(1) The ability to raise capital and the role that capital plays in determining competition in all U.S. industry;

(2) The unique importance of capital to the computer industry, because of the rental-base nature of the general purpose computer systems market;

(3) IBM's computer systems competitors and the degree to which they have "successfully" entered the industry and can provide meaningful competition in the future;

(4) The computer peripheral subsystems manufacturers as a case study in the effectiveness of the capital barrier to block entry into the industry; and,

(5) The outlook for even less competition in the computer industry, because of the highly selective nature of investment interest in the industry today.

INTRODUCTION

The computer industry is the fastest growing major industry in this country and in the world. The industry has already contributed to vast social, economic and political change in its brief, twenty-year history; and the next twenty years promise to be even more dynamic because of quantum leaps in semiconductor technology, the increased sophistication of the computer user and the marriage of computer and communications technologies.

The industry combines the best of our natural resources: in management and systems skill, capital and technology. The future progress of the computer industry will have a significant impact on all other important industries in this country, on national defense and on the future productivity of the U.S. economy, in general. The products and services of the industry will reach more and more into our daily lives.

Yet, there are very few companies in the computer industry that receive serious investment consideration today. The answer to the apparent paradox of a growing and dynamic technology-based industry and the highly selective nature of current investment interest can be found in the structure of the computer industry.

There are two major barriers to entry into the general purpose computer industry: the "systems lock" and the highly capital intensive nature of the industry. Together they form an absolute barrier to entry that would allow IBM to control virtually 100% of the general purpose computer market, in my opinion, if IBM did not operate under self-imposed constraints that limit its market share to 60–70%. Basic to establishing and maintaining the two principal barriers to entry is IBM's policy of marketing a total bundled computer system on a short term, risk lease basis.

Testimony before this subcommittee has extensively addressed the esoteric subject of the "systems lock" and IBM's related marketing support activities. Simply stated, the high level of end-user systems' support provided by IBM combined with the investment in IBM software by a computer installation discourages users from switching to another systems manufacturer.

The perspective that I hope to bring to these hearings is the unique importance of the financing question to the structure of the computer industry; and some insight into how the highly capital intensive nature of the industry is created and maintained to provide an effective barrier to entry.

COMPETITION AND THE ABILITY TO RAISE CAPITAL

The basic thrust of my remarks can be generalized to apply to all highly concentrated industries: in order to have competition within an industry, competitive entities must have the ability to raise or to internally generate the capital necessary to successfully compete. This consideration is particularly important today because of the increasing concentration of the control of investment assets at major financial institutions and because of the shortage of capital that exists today in this country and will continue to exist for the foreseeable future.

My background is financial, not legal, but as a financial analyst many elements of Chief Justice White's and Judge Hand's definition of a monopoly are exactly the same as the generally accepted criteria for the ideal equity investment at most large financial institutions; a company that has the dominant position in its industry and the power to exclude competition: and a company that has the ability to control prices within its industry. I might add one other criterion of the ideal equity investment: a company that also has the capability to frustrate any legal challenge to its dominant industry position on antitrust grounds.

The similarity between the definition of a monopoly by Chief Justice White and Judge Hand and Wall Street's definition of the ideal equity investment helps explain the now-infamous, "two-tier" equity markets that have developed in this country over the past few years. Institutional investors have been primarily interested in accumulating large equity investments in their "favorite fifty" and have had only passing and lukewarm interest in other equity investments. I submit that it is no accident that the top five companies on the list of the fifty institutional favorites, IBM, Exxon, American Telephone, Xerox and Eastman Kodak are all being challenged on antitrust grounds by either the Justice Department, the FTC or by private litigants.

THE UNIQUE IMPORTANCE OF THE FINANCING QUESTION TO THE GENERAL PURPOSE COMPUTER INDUSTRY

Although the ability to raise capital is an important consideration in determining real and potential future competition in any industry, it is a uniquely important factor in the general purpose computer industry. Its unusual importance to the computer industry relates to IBM's practice of marketing a total bundled computer system on a rental basis.

Some clarification of the market that is being addressed is necessary. The general purpose computer systems market refers to systems typically used in a commercial and in a mixed commercial/scientific data processing environment in manufacturing, retailing, banking, federal and state government, insurance, etc. It excludes dedicated applications computers such as minicomputers and microprocessors, not because it would make a meaningful difference in any total market share calculation, but because the structure of those markets is significantly different from a financing point of view. Specifically, minicomputers and microcomputers are sold outright to end users and to original equipment manufacturers (OEMs), while general purpose systems are typically marketed on a rental or lease basis. My remarks also exclude computer supplies such as computer tape, disk packs, and punched cards because, in general, supplies also are sold outright to data processing installations.

The general purpose systems market is by far the largest and most important segment of the total computer market. The installed base of general purpose systems accounted for 91.2% [1] of the total domestic installed base of computers at year-end 1973, based on dollar value; and the total dollar value of installed computers was $29.9 billion, including dedicated applications computers. Of the total domestic general purpose systems installed base at year-end 1973, IBM's market share was 63.8%.

IBM's practice of marketing computer systems on a short term, rental basis holds the key to the high capital barrier to entry into the industry; and can best be illustrated by example.

[1] Source: All market share and installed base data from International Data Corporation, Newtonville, Massachusetts.

A typical manufacturing company that produces and markets $100 million in products in a year records sales of $100 million and a pretax profit. If, on the other hand, that same manufacturing company produces and ships the $100 million in product on a short term, risk lease basis (the standard in the general purpose computer industry) a large negative cash flow and a substantial reported loss is realized under generally accepted accounting practices.

The first year of operation of two identical companies—with one shipping on an outright sale basis and the other shipping on a rental basis—can be illustrated as follows:

TABLE 1 [1]

[In millions of dollars]

	Outright sale	Rental base
Shipments (1st year)	100	100.0
Revenues	100	12.5
Cost of sales	35	4.4
Gross profit	65	8.1
Expenses:		
Marketing	25	25.0
Research and development	10	10.0
General and administrative	10	10.0
Total	45	45.0
Net profit (loss) before taxes	20	−36.

[1] Example is obviously oversimplified but the numbers are a reasonable approximation of the revenue and cost structure of the general purpose computer industry. Exact numbers, of course, are not available because they are a closely guarded secret at most companies in the industry.

The difference in realized revenues between the manufacturing company that sells outright and a company that ships its product on a lease or rental basis is straight forward. Typical computer industry leases pay out over 48 months (the sale price is about 48 times monthly rental). Consequently, in the first twelve months of installation, computer equipment generates 25 percent of the full purchase price or $25 million in my example. During the first full year, assuming a uniform monthly shipment level, the actual revenues booked are only one half of that amount or $12.5 million.

Most expense items, however, remain the same, independent of whether the equipment is shipped on an outright sale or on a rental basis. The only exception is manufacturing costs, which are capitalized and depreciated over the estimated future life of the equipment, typically four to six years. The expense items that remain the same (marketing, research and development and administrative costs) are a large portion of the total expense in the computer industry.

Consequently, the manufacturing company is forced to ship its product entirely on a rental basis records a first year operating loss of $36.9 million on shipments of $100 million—in contrast to a profit of $20 million for the typical manufacturing company. If no new products were shipped on a rental basis in the second year and expenses were reduced accordingly, revenues of $25 million would be recorded for the rental-based manufacturer and a profit would be realized. But, that would be a company in liquidation. If, on the other hand, the management of the company addressing a rental market was attempting to build a viable company over the long term (the usual definition of successful entry into an industry) shipments could not be reduced to zero in the second year but would, in fact, have to be increased on a year-to-year basis.

Increased shipments on a rental basis, in turn, result in an even larger reported loss in the second year and increasing losses for some time. Eventually, the losses peak and begin to decline gradually until, finally, a breakeven level is reached. Black ink arrives for the first time when shipments are high enough to realize competitive economies of scale in manufacturing, software development and product development such that the gross profit contribution from the rental base exceeds the high fixed cost of marketing, systems support, field service, research and administration.

The foregoing illustrates one of the many contradictions of a rental-base business: the higher the incremental shipments in any year (the more successful the company is in shipping product that year) the greater the reported loss in that year.

The problem from a financing point of view is enormous. An investor is being asked to commit capital to a business that may now show a profit for perhaps as long as 10 years; and will only show a profit at that time if management does not make any important mistakes along the way; if the economy does not slump into a recession at the wrong time; if the dominant company in the industry does not become sufficiently concerned to focus its competitive strengths on the new company, which could result in premature product obsolescence; and if sufficient capital can be raised along the way to keep the company alive long enough.

The capital that must be raised is also equity and equity related, risk capital since straight debt will not be made available to a company realizing a negative cash flow and operating at a loss. Consequently, most of the companies that have attempted to enter the general purpose computer market have been involved in other businesses that could help support some of the initial capital demands, such as General Electric, Philco, Bendix, NCR, Burroughs, Sperry Rand, RCA and Honeywell.

Not all general purpose computer equipment is shipped on a rental basis. As a result of the 1956 Consent Decree, IBM is required to sell equipment to interested customers; and IBM's pricing is structured such that some portion of shipments are sold outright. But that portion is relatively small and the imposed standard in the industry remains the short term, operating lease. Consequently, the fact that some customers purchase equipment outright only slightly reduces the total capital commitment necessary to successfully enter the industry. Prior to 1956, IBM would only rent computers and tabulating equipment to customers.

THE EXPERIENCE OF IBM'S SYSTEMS COMPETITORS

The history of the general purpose computer industry clearly establishes that reaching the critical mass level necessary for "successful entry" takes a long, long time and huge amounts of capital.

RCA provides a good example, since it attempted to compete directly with IBM in the general purpose systems market with many ex-IBM personnel in senior management positions. In 1970, RCA seemed to be fully committed despite many years of struggling. In its 1970 annual report, RCA stated that its "most significant growth area in the seventies is expected to be in information processing."

In Sepember, 1971, RCA announced that it was withdrawing from the general purpose computer field. RCA's computer operations were sold to the Unvac Division of Sperry Rand in December, 1971; and the company took a pretax loss that year of $490 million as a result of its venture into computers, the largest single loss in U.S. business history. At the time RCA left the industry, its computer operations were still showing a loss. RCA had already committed capital well in excess of the final writeoff of $490 million; and estimated at the time that it would have to commit an additional $500 million in order to establish RCA as a viable company in the computer industry.

General Electric's experience was similar; and in 1970 GE sold its computer systems operations to Honeywell.

Even among IBM's systems competitors that have survived, it is unclear to what extent they have "successfully" entered the general purpose systems market:

Honeywell Information Systems (HIS), which acquired GE's computer operations in 1970, is the second largest company in the general purpose systems market with a 9.4% market share and revenues of $1.2 billion in 1973. HIS's pretax profit margin was only 5.3% in 1973 after allocation of interest expenses; and the total Honeywell Corporation realized a return on stockholders' equity of only 10.8% in 1973, excluding an unconsolidated financing subsidiary. Total consolidated short term debt, long term debt and minority interest was $885 million at year-end 1973 compared to stockholders' equity of $952 million; but Honeywell Finance, an unconsolidated finance subsidiary, had additional debt outstanding of $319 million and equity of $66 million at year-end 1973. The early success of HIS in the computer systems market was in part due to the fact that it initially avoided the IBM software compatibility problem by making the H-200 series, introduced in 1964, software compatible with the second generation, IBM 1401 series through a program called the Liberator.

The *Univac Division* of Sperry Rand had only 8.1% of the total domestic installed base of general purpose systems at year-end 1973, despite the fact that Univac acquired the RCA installed base in late 1971; delivered the first commercially built computer system in 1951; and had about 15–20% of the predecessor tabulating machine market in the middle 1950s. Univac first broke even in fiscal 1966, following a $290 million loss the previous year. Univac's after tax profit margin in fiscal 1974, which ended March 31, 1974, was approximately 5.8%; return on stockholders' equity of the Sperry Rand Corporation was a respectable 12.1%; and the company's debt level was not unusually burdensome. On balance, Univac's position in the general purpose market is strong relative to competition (with the exception of IBM), but Univac's total market share does not reflect the many early advantages that the company held.

Burroughs Corporation is the strongest company financially among IBM's general purpose computer systems competitors. The company has compiled an excellent record of revenue and profit growth over the last decade; and has been an important technological innovator in the computer industry. In 1973, Burroughs recorded a pretax profit margin of 16.2% and a return on stockholders' equity of 13.3%—second only to IBM. Burroughs' success was in part due to the fact that it addressed the lease-base segment of the general purpose systems market at a measured pace; while emphasizing segments of the data processing market where equipment could be sold outright rather than leased, such as business minicomputers (Series L), terminal computers (Series TC) and the banking industry generally. That strategy allowed Burroughs to record a high rate of annual revenue and profit growth; which in turn allowed Burroughs to successfully raise new capital, including $110 million in equity capital and $100 million in subordinated debt in 1970 alone.

NCR's computer systems operations were profitable for the first time in recent history in 1973. The company entered the computer market in 1953 through the purchase of Computer Research Corporation. NCR's total pretax profits in 1973 were $141.9 million, following a reported loss of $97.9 million in 1972. NCR's 1973 pretax profit margin was 7.8% and its after tax margin was 3.9%. The company's return on stockholders' equity in 1973 was 11.7%. NCR had to stay in the computer systems business because it was obvious that its traditional product lines—cash registers and accounting machines—would eventually be on-line to a computer system. At year-end 1973, NCR had 2.7% of the domestic installed base of computer systems.

Control Data realized early success and profitability as a computer systems manufacturer capable of delivering very large and competitive price/performance systems primarily for application in areas where the system was usually purchased outright, such as in defense, science and education (including a major portion to U.S. Government applications). Later efforts to broaden the company's base into the commercial general purpose systems market led CDC directly into the "systems lock" barrier and into the capital barrier to entry—as well as into an aggressive IBM.

The acquisition of Commercial Credit by Control Data in 1968 helped moderate the capital demands related to entering the rental-base market; but the transition has been extremely difficult and probably would have been impossible except for Commercial Credit. In 1973, Control Data reported revenues from computer operations of $948.2 million and pretax profits of $41.8 million, indicating a pretax profit margin of only 4.4%. CDC's 1973 results benefited from the settlement of an antitrust suit against IBM filed in 1968 and valued at $100 million. In 1970–1971, CDC's computer operations lost a total of $64.5 million and they were only marginally profitable in 1972.

Two new domestic companies that attempted to enter the general purpose computer systems market over the past five years, Memorex Corporation and Amdahl Corporation, have had problems. Memorex terminated its systems program in 1973 and took a loss of $40 million that year. Amdahl attempted to raise public financing for the first time in 1973 in order to complete development and begin initial shipment of its advanced, general purpose computer systems, which were designed to compete in the IBM System/360 and System/370 market.

Amdahl has an impressive management team. Gene M. Amdahl, the President, was manager of achitectural planning for the entire IBM System/360 family of computers and later the Director of Advanced Computer Systems at IBM. Nevertheless, the company was unsuccessful in its attempt to raise public financing and the fate of the company is currently uncertain. The Amdahl case is interesting because the company's design incorporates high speed, LSI tech-

nology and advanced computer technology. Japanese interests may now acquire control of Amdahl because sufficient capital could not be raised in this country.

The financial highlights of IBM's principal general purpose systems competitors are summarized on the following page (Table II). Burroughs and NCR do not provide profit data for their general purpose systems' product lines and only Control Data provides a separate balance sheet for its computer operations.

TABLE II.—GENERAL PURPOSE COMPUTER SYSTEMS MANUFACTURERS: 1973 RESULTS

[Dollar amounts in millions]

	Revenues	Pretax income	Net (Income)	Net Margin (percent)	Cash flow [1]	Return on shareholders' equity (percent)	Market share [2] (percent)
IBM	$10,993	$2,947	$1,576	14.3	$3,278	19.2	63.8
Honeywell	2,408	190	97	4.0	367	10.8	
HIS	1,177	[3] 62	[3] 29	[3] 2.5			9.4
Sperry Rand [4]	2,641	212	113	4.3	262	12.1	
Univac [5]	1,239		71	5.8			8.1
Burroughs	1,284	208	116	9.0	249	13.3	5.2
Control data [6] computer operations	948	42	17	1.8	104	2.0	3.6
NCR	1,840	142	72	3.9	218	11.7	2.7
All others, including IBM plug-compatible peripheral manufacturers with a 4.8 percent share							7.2
Total							100.0

[1] Net income plus depreciation.
[2] General purpose installed base at year-end 1973; International Data Corp.
[3] Interest allocation by division is estimated; Basic Analysis of Honeywell, Inc. by Lehman Brothers, Inc., May 16, 1974.
[4] For the fiscal year ended Mar. 31, 1974.
[5] Sperry Rand's business equipment product line, primarily Univac.
[6] Excludes Commercial Credit Co.

Source: Company data, primarily 1973 Annual Reports.

The data [3] raises questions about the staying power of some of the remaining companies in the industry. Burroughs is the only company that realized profit margins in 1973 that were in excess of the average of all major U.S. corporations last year (5.9%),[4] although Univac was just slightly below the average; and all of IBM's competitors realized a lower return on shareholders' equity in 1973 than the average of all major U.S. companies last year (14.0%). The relative difference in profitability within the computer industry is even more significant than the comparisons indicate, since IBM's accounting for profits is in general more conservative than competition. Also, total corporation data masks the low level of profitability of computer systems operations in many cases.

Since capital is a major barrier to entry into the computer industry, the ability to internally generate cash to meet future capital requirements is an important measure of the ability of any company to compete effectively in the future. IBM's cash flow in 1973 at $3.3 billion seems overpowering relative to its nearest competitor, Honeywell, Inc., with cash flow in 1973 of only $367 million. Further, IBM held cash and equivalents at year-end 1973 of $3.3 billion, excluding $496 million in securities held for repayment of long-term debt. In contrast, a number of IBM's general purpose systems competitors are burdened by relatively high debt levels.

The ability of IBM's competitors to raise outside capital is equally uninspiring for many of the reasons that have already been mentioned: profit margins and return on stockholders' equity below the average of all major U.S. corporations in 1973, despite more liberal accounting than IBM; high debt levels; and low market shares. Also, excluding Burroughs, price-earnings ratios are relatively

[3] Some additional companies could be included in the general purpose computer industry such as Xerox Data Systems (formerly Scientific Data Systems), the Business Machines Division of the Singer Company and Digital Equipment Corporation, the leading producer of minicomputers. However, including those companies would unnecessarily complicate the data, while adding little to any understanding of the industry because their market share is too small. Singer and Digital Equipment both have less than 1% of the domestic installed base of general purpose computers; and Xerox Data Systems' market share was only 1.4% at year-end 1973.

[4] Data compiled by Investors Management Sciences, Inc., a subsidiary of Standard & Poor's Corporation.

low, ranging from a high of 10 times for Honeywell and Sperry Rand down to 6 times for Control Data, based on 6/30/74 common stock prices and earnings for the twelve months ended 3/31/74; and, again excluding Burroughs, the ratio of common stock price to book value at 6/30/74 indicates that any new common stock offerings could dilute current stockholders' equity at a number of companies in the industry.[5]

The future availability of external financing must also be viewed in the context of the history of the industry. Through the decade of the 1960s, the mystique of the computer and the hypnotic influence of possibly approaching IBM's profitability attracted considerable external capital into the industry. The myth that many companies would be able to achieve rapid growth and high profitability in the computer systems market has been shattered by the reality of the economics of the industry.

All of the previous financial considerations indicate that the industry could—and perhaps will—become even more highly concentrated than it is today, if capital remains a major barrier to entry. Burroughs Corporation is the only exception among IBM's competitors, because of the high level of profitability and of investor recognition that the company has achieved, despite the fact that many analysts suspect that the company's computer systems product line is well below the corporate average in profitability.

Some reasons for Burroughs success have already been discussed, but one factor deserves repetition: Burroughs has been very successful at avoiding too heavy a commitment to shipments of systems on a rental basis by concentrating on products and market areas where equipment can be sold outright. If Burroughs' policy of managing the sales/lease mix in favor of outright sales can be maintained, it can probably continue to gradually increase market share. However, if it attempts to accelerate its market penetration by dramatically increasing lease shipments, current earnings will decline and the company's ability to finance growth will suffer.

A CASE STUDY IN THE DYNAMICS OF THE CAPITAL BARRIER: THE INDEPENDENT COMPUTER PERIPHERAL EQUIPMENT MANUFACTURERS

The history of the independent peripheral equipment manufacturers' attempt to penetrate the general purpose market in the late 1960s further illustrates the extent to which capital acts as an effective barrier to entry into the industry and the dynamics of the interaction.

Prior to the introduction of third generation computer systems in 1964–1966, independent peripheral equipment manufacturers primarily supplied peripheral such as printers, digital tape drives and disk drives to computer systems manufacturers on an original equipment basis. Those manufacturers, in turn, incorporated the peripherals into their systems to be marketed to computer installations in competition with IBM systems.

In the late 1960s, independent manufacturers began to address the end-user market directly, with particular emphasis on the IBM rental-base of peripherals attached to the IBM System/360 family. The development of the end-user market for peripheral equipment was the result of a number of factors:

(1) The potential market was large, particularly among IBM systems users, because standard peripherals and interfaces were used over virtually the entire IBM System/360 family;

(2) The economies of scale of product development and maufacturing were not significant barriers to entry;

(3) Technological progress in peripherals had been slow—perhaps because IBM never had to compete on a peripheral subsystem level (all previous end-user competition within the industry had been on a total bundled computer system level);

(4) Profit margins were excellent, based on manufacturing costs and projected marketing and field service expenses;

(5) Peripherals were an increasingly large portion of the dollar value of a total computer system (in 1960 peripherals were about 20% of the total dollar value of a system and the central processing unit was 80%; by 1970 the split was about 50–50; and by 1980 peripheral subsystems are expected to represent about 80% of the total value of a system);

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[5] The ratio of common stock price at 6/30/74 to year-end 1973 book value ranged from a premium of 23% for Sperry Rand to a discount of 57% for Control Data, except that Burroughs was at a premium of 293% and IBM was at a premium of 210%.

(6) One of the two major barriers to entry into the general purpose computer industry, software compatability with IBM, was avoided by making the independent peripherals fully compatible with IBM software and systems, such that the peripherals were "transparent" to the mainframe—they looked exactly like IBM peripherals to the central processing unit; and, finally,

(7) The other major barrier to entry—capital—was reduced significantly, in part by investment enthusiasm for young technology companies in the late 1960s but more importantly by the fact that an independent peripheral equipment manufacturer could address one market (e.g. the digital tape drive market) and was not forced to develop an entire computer systems family, including central processing units, an operating system, applications software and all of the related peripheral subsystems—as a prerequisite to entry.

The initial entry into the IBM end-user market of companies with capabilities in compatible peripherals was hardly noticed. In 1966, DuPont requested bids for digital tape drives to replace the drives on its IBM computer system; and, The Telex Corporation, a tape drive manufacturer, won the contract. Through 1967–1969, production was increased, a marketing/field service organization was built, end-user credibility was established and attractive financing packages were negotiated to sell equipment outright to third-party leasing companies. The ability of Telex to minimize the capital burden of building a rental-base by selling equipment outright to third-party leasing companies reflected confidence in the attractive economies of the plug-compatible market.

By 1970, the success of Telex and the availability of initial capital had attracted a number of independent competitors into the industry including Memorex, California Computer Products, Ampex, Potter Instruments, Storage Technology, Information Storage Systems and Marshall Industries. The domestic recession of 1969–1970 also gave the IBM plug-compatible manufacturers a considerable boost, since data processing installations were looking to cut costs and replacing higher-priced IBM peripherals with less expensive and, in most cases, superior products, was a logical choice. Finally, the General Accounting Office released a study that found that federal agencies could save taxpayers $200 million by using independent peripherals.

During 1970, shipments of independent peripheral subsystems manufacturers increased sharply. Telex alone shipped about $80 million in equipment and was budgeting shipment levels for 1971 that were approaching the levels of some of the surviving systems manufacturers that had been attempting to penetrate IBM's market for a considerably longer period of time.—Plug-compatible manufacturers were achieving what IBM's systems competition had failed to do—they were providing some real competition.

Then, after careful study, IBM began to react or overreact—depending upon one's perspective—to competition on a peripherals subsystem level. In September, 1970, IBM introduced a "new" disk drive subsystem, the IBM 2319A, which was actually a repackaged IBM 2314 subsystem, the most popular product being marketed by independent competitors at the time. The IBM 2319A was introduced at a significantly lower price than the functionally equivalent IBM 2314. In December, 1970, IBM introduced the IBM 2319B, which extended the price cut to disk subsystems used on all System/360 and System/370 family computers, and reduced prices further by eliminating extra use charges. At the time, IBM's share of the 2314 type disk subsystems market attached to IBM computer systems was 94%.

IBM's price reductions on disk drive subsystems were followed in May, 1971 by the introduction of the Fixed Term Plan (FTP), a new lease plan that provided rental reductions for IBM customers that signed one and two year leases with penalty clauses for cancellaton and which also eliminated extra use charges. FTP represented another substantial price cut by IBM and was only applicable to those products where IBM was experiencing competition from plug-compatible manufacturers: disk drive subsystems, tape drive subsystems and printer subsystems. IBM also reduced its purchase prices of those products at the same time. Two months later, IBM raised prices on central processing units and memories by an amount that offset the price decreases represented by FTP, according to IBM's estimates.

At the time, IBM was also beginning to experience competition from independent memory subsystems manufacturers that were offering add-on memory for System/360 and System/370 computers at attractive prices. After studying the situation in detail, IBM introduced its new System 370/158 and 370/168 computers with semiconductor memory at lower prices than the cost savings seemed to justify and with higher central processing unit prices.

The losses experienced by IBM's peripheral subsystems competitors in 1971–1973 [6] were staggering relative to the size of those companies. Some of the losses could be directly related to IBM's price reductions; some were the result of manufacturing problems and other difficulties unrelated to, but certainly compounded by, IBM's actions; while some of the reported losses were due to the inability of those companies to favorably complete financing arrangements that would have eased the capital burden.

Memorex Corporation, a highly successful and profitable manufacturer of computer tape and disk packs for many years prior to its entry into the IBM end-user disk subsystems market, reported a pretax loss of $24.9 million in 1971, a profit of $1.9 million before taxes in 1972, and a loss of $119.1 on revenues of $176.9 million in 1973, including writeoffs from its discontinued computer systems program and from previously deferred expenses.

The Telex Corporation reported a loss of $18.0 million for the fiscal year ended March 31, 1973 on Telex Computer Products' revenues of $43.3 million and shipments of $98.1 million. In fiscal 1974, Telex's computer operations lost $35.4 million on shipments of $62.7 million. The fiscal 1974 loss effectively wiped out all of Telex's stockholders' equity.

California Computer Products, Inc., the leading producer of computer graphic systems, was less heavily committed to the end-user, plug-compatible disk drive market in 1970, when IBM started to react. Nevertheless, the company sustained a loss of $12.9 million in its fiscal 1972 year and was only marginally profitable in its fiscal 1973 year ended June 30, 1973, after more than 10 years of profitable operations as a specialized peripheral subsystems manufacturer.

Despite the sharp financial setback of the peripheral subsystems manufacturers throughout the 1971–1973 period, some companies, through superior product lines, strong management or simply luck, were not forced to drastically cut back product development and end-user marketing programs and were continuing to enjoy strong customer response for their products. Also, some peripheral companies were continuing to expand rapidly in product areas where the penetration of IBM's market was too small to invite a competitive reaction, such as in data entry and remote batch terminals. But there was one major missing ingredient: NEW CAPITAL was no longer available. IBM's actions served notice to Wall Street that competition on a peripheral subsystem level had little chance of success—and Wall Street listened. IBM's promise of doom had the effect of a self-fulfilling prophecy.

Telex was able to complete a $27.5 million subordinated debenture financing with warrants in 1971; but the company has been unable to tap the long term capital markets since that time. Memorex managed to complete the private financing of a leasing subsidiary in the amount of $142 million in 1970, but has been unable to raise additional long term capital since that time. California Computer Products was able to raise $10 million through a convertible debenture financing in January, 1972, and also has been unable to raise permanent capital since that time.

Short-term funds were provided to peripheral subsystems manufacturers by commercial banks, since bank lines can be collateralized by inventories, receivables and rental equipment; and since, in many cases, it was necessary for individual banks to advance additional funds and to restructure repayment schedules in order to protect existing loans. But short-term financing is expensive and restrictive as well as temporary; and it is hardly the basis for establishing a sound financial structure in an expanding market.

California Computer Products successfully redirected its memory systems efforts away from the end-user market to the original equipment market and has become the principal supplier of disk drives to Univac, Burroughs and a number of minicomputer manufacturers. The success of this program should allow CalComp to return to very profitable operating levels for the year ended June 30, 1974. But the company has still been unsuccessful in its attempts to raise permanent capital at reasonable prices; and it is burdened by a heavy debt load and bank lines that are currently costing in excess of 16% annually in interest charges and compensating balances.

Without the ability to raise capital, the outlook for end-user independent peripheral equipment manufacturers was bleak through 1972 and 1973. Then, in September, 1973, the antitrust suit filed by Telex against IBM was decided in favor of

[6] IBM's price adjustments during the period had no visible effect on the price schedules of IBM's computer systems competitors.

Telex. A number of the business practices adopted by IBM to contain the penetration of the IBM peripheral subsystems market were found to be in violation of Section 2 of the Sherman Act. Telex was awarded $259.5 million in an amended decision; and some injunctive relief was granted to promote future competition in the industry. The decision also found Telex guilty of misappropriating IBM trade secrets. The Telex vs. IBM case is now before the U.S. Court of Appeals for the Tenth Circuit.

Judge Christensen's decision in Telex vs. IBM seemed to represent a new lease on life for the independent peripheral subsystems manufacturers. The decision recognized peripheral subsystems as individual and distinct submarkets and it recognized IBM's monopoly power in those submarkets, while providing a meaningful damage award. Yet, following a very brief period of investment interest immediately after the surprise decision, Wall Street again turned a cold shoulder toward peripheral manufacturers.

The stated reasons for the lack of investment interest were mixed: the Telex decision could be overturned or it could be in the federal courts for another five years; the peripheral manufacturers had fallen too far behind in product development to benefit materially; there is too much risk in the industry because of IBM's ability to control prices and the pace of technology. All the reservations were valid, especially when combined with the most important consideration: "Where are the peripheral subsystems manufacturers going to get the capital necessary to regain their previous position in the industry?"

The immediate impact on the general purpose computer end-user of the success of plug-compatible peripheral manufacturers was significant. For the first time, IBM computer users enjoyed a choice of equipment vendors for peripherals to be used with their systems and were able to realize meaningful reductions in total data processing expenses and improved systems performance by acquiring independent equipment. And, technological progress was accelerated by IBM's attempts to match—and surpass—superior competitive equipment, which provided additional benefit to the computer user. IBM's systems competition also benefitted from the availability of superior products from independent sources, which allowed them to concentrate their limited resources on central processing unit and software development.

The future contribution of a healthy computer peripheral equipment industry could have been even more dramatic. The ability to enter the industry with a single product line raised the possibility of expanding that line to include additional peripheral products—and, eventually, a central processing unit and a total general purpose computer system. But that potential will never be realized, because the capital necessary is simply not available today even if a company demonstrates that it has a superior product, capable management and current profitability.

The emergence of the independent peripheral equipment manufacturers as an important force in the industry and their current capital problems is a case history of the critical role that financing plays in the structure of the general purpose computer industry. The product and marketing strategy adopted by independents to penetrate the general purpose market avoided the IBM compatibility problem and reduced the capital requirements considerably by focusing on a single component of a total computer system. Nevertheless, because of IBM's unusual competitive reactions, sufficient capital can no longer be raised to establish strong and viable competitors over the long run.

At a recent management seminar, Mr. Edward Orenstein, President of Data 100 Corporation, a peripheral subsystem manufacturer that participates in a submarket that has not warrented direct IBM action, was asked the question "Could you please summarize what you consider to be your competitive advantages?"

Mr. Orenstein's answer was, and I quote "Our biggest single competitive advantage is a financial one. We are primarily in the leasing business. If a potential competitor, which has started out manufacturing on an OEM basis, then goes into the leasing business, he must be ready to take a two-or-three-year setback in profitability. That's usually lethal. Companies usually can't survive that."

Clearly, he was referring to Data 100's advantage over any competitor in the early stages of entry into the remote batch terminal market when he referred to Data 100's biggest single competitive advantage as a financial one. Data 100 has approximately 10% of the remote batch terminal market, a number of other competitors share 10 to 15% and IBM has the remaining 75 to 80%. If Data 100's

principal advantage over new competitors is a financial one, what is IBM's biggest single competitive advantage over Data 100? IBM had total revenues of $11.0 billion in 1973. Data 100 had hotal revenues of $42.1 million in 1973. IBM's cash flow (net income plus depreciation) was $3.3 billion in 1973, while Data 100's cash flow in 1973 was $8.0 million.

SOME CONCLUSIONS AND RECOMMENDATIONS

Raising capital is a problem for almost all U. S. industry today. Only the strongest companies financially have ready access to new capital because of the chaotic state of capital markets in general and specifically because of financial institutions' highly selective investment policies.

The deterioration of capital markets over the last few years has further contributed to the problems that this subcommittee is addressing, since it tends to promote even higher industrial concentration. And, difficult capital markets will remain a fact of life in the industrial world for many years to come because of the third world economic revolution, high consumption levels and the large projected demand for new industrial capacity to meet the future requirements of our society.

Broad capital market considerations have certainly contributed to the inability of IBM's competitors to raise capital. But unlike most U.S. industry, new capital is not only important to the general purpose computer industry, it is the most important consideration and very effective barrier to entry into the industry.

The history of the general purpose computer systems manufacturers indicates the extent to which the capital barrier and the "systems lock" have worked to minimize competition in the industry. Even the "surviving" systems companies as a group look weak from a financial point of view, relative to IBM. Comparing IBM's financial strength to the other systems companies' ability to internally generate and to externally raise capital indicates that the industry could—and perhaps will—become even more highly concentrated in the future.

The rise and fall of the independent computer peripheral subsystems manufacturers as meaningful competitors in the end-user general purpose market further dramatizes the effectiveness of the capital barrier. Competing with IBM on a peripheral subsystems level avoided the compatibility problem and reduced the capital commitment necessary to enter the market. Nevertheless, IBM's ability to focus on peripheral subsystems companies by highly selective price cuts has effectively eliminated them as meaningful competitors, because they can no longer raise the capital necessary to compete.

The capital barrier to entry combined with IBM's practice of marketing a total bundled computer system family gives IBM a high degree of control over the general purpose computer market, if not absolute control. The ability of IBM to shift profitability from peripheral subsystems to central processing units and back again, depending upon the competitive realities of the market at that time, makes it almost impossible to compete on any level but on a total systems level—where the capital barrier has proven to be almost prohibitive. Profitability can also be shifted among the various peripheral subsystems, between the central processing unit and the operating system and from one end of the computer systems family to another, if effective competition enters the market in any of those areas. IBM has the added advantage over potential competitors of controlling interface standards and new media standards in the industry; of being able to deny field service support; of controlling the development of the operating system; and of possessing the only truly accurate data in the industry about market size and product profitability.

IBM's ability to orchestrate relative profitability and its many other advantages over competition would not be so important if the industry giant did not fully utilize all of those facilities in its competitive battle with the plug-compatible peripheral subsystems manufacturers. Profitability was shifted (from peripheral subsystems to the central processing units following the introduction of FTP and from add-on memory to the central processing units with the introduction of the System 370/158–168); interface information remains a closely guarded secret at IBM; media standards are changed, but the new "de facto" standard is not immediately released to the industry (the new disk pack for the Winchester disk subsystem); field service support is occasionally denied to IBM systems with non-IBM equipment attached (as in the case of Advanced Memory Systems' add-on memory); changes in IBM's operating system have severely disrupted a competitor's business (Sanders Associates' terminal busi-

ness) : and the lack of accurate industry data has hampered competition (in the late 1960s disk pack manufacturers were increasing production based on estimates of the pack market that IBM knew to be about twice the size of the actual market).

The effect of IBM's competitive response to the initial success of subsystems manufacturers has been to warn Wall Street that competition on any level except on a total integrated systems level has no chance of success. And, the warning was not a subtle hint. Major financial institutions have suffered—or stand to suffer—large financial losses because of the experience, including Bank of America (because of its heavy commitment to Memorex), Continental Illinois National Bank (Telex's lead bank), and Metropolitan Life Insurance Company (because of its equity investment in Telex).

In the context of the disappointing performance of IBM's general purpose systems competitors and the harsh lesson of the peripheral subsystems manufacturers, it is not surprising that the flow of new capital into the computer industry has all but stopped. My contracts with major financial institutions today indicate that they have no interest in investing in any peripheral subsystems manufacturers that are competing with IBM in the end-user market; and that they have very limited interest in investing in companies that are competing with IBM on a general purpose systems level.—Since capital is so critical to success in the industry, that can only mean that competition in the industry will decline even further in the future.

Should the computer industry be restructured? The answer to that question seems simple to this writer. A competitive computer industry is vital to our national defense and to our continued economic and technological development. And today, the industry is not only highly concentrated, but the present structure of the industry suggests that there will be even less competition in the future.

IBM would have us believe that there is no general purpose computer systems market—that there is only a total data processing market and that IBM's share is relatively small. IBM's definition of the market is similar to suggesting that there is no domestic automobile market—that there is only a transportation market and that trains, buses, planes, taxicabs and roller skates should all be included in the market.

IBM's broad definition of the data processing market is similar to my transportation industry analogy but even that comparison does not fully describe the nature of the industry. Data processing is much more basic and, because it is so basic, control of the largest market within the broadly-defined data processing industry (the general purpose computer systems market) also grants effective control over technology in many areas that are critical to the future of this country.

But, isn't technological progress best served by having one giant company controlling new product development, especially when that company spends in excess of $700 million annually for research and development? Unfortunately, the present structure of the computer industry retards technological progress. IBM's marketing strategy is to introduce new products when competitive pressure within the industry demands advanced products. In the absence of competition, the rental-base nature of the industry makes it more attractive for IBM to keep installed products out in the field for as long as economically possible. Consequently, IBM seldom takes the lead in new technological developments in the industry, except where there is no existing base of product.

Even today, the investment community is reluctant to finance any new technological ventures into the general purpose systems market, because it is well aware of the fact that IBM stands ready with its large technological reserve to match any new developments; and it probably has a product ready to go if a new, innovative company begins to achieve some measure of success. What will happen when IBM's technological reserve is broadened into even more basic research areas?

Although the answer to the question of whether the industry should be restructured seems simple, the question of how the industry should be restructured is extremely complex, in part because it has been structured to resemble a monolithic industry. My remarks have focused primarily on the rental-base nature of the computer market and on IBM's equipment financing business, because they are key elements in IBM's dominance of the general purpose computer market; and they must be addressed in any restructuring plan. Any future restructuring of the industry also should recognize that IBM's data processing operations are actually the sum of a number of businesses, including

the development, production and marketing of central processing units, operating systems, applications programs and numerous peripheral subsystems such as tape drives, disk drives, printers, communications controllers and terminals; and that it is also in the business of providing a number of services such as field maintenance, education and systems engineering, as well as lease financing. Any one of those businesses could potentially be established as separate and independent competitive entities, significantly increasing overall competition within the industry.

AFTERNOON SESSION

Senator HART. The committee will be in order.

Our next witness is the vice president and associate director of research of Shareholders Management Co., Mrs. Marilyn Walter-Carlson.

We welcome you.

STATEMENT OF MARILYN WALTER-CARLSON, VICE PRESIDENT AND ASSOCIATE DIRECTOR, RESEARCH SHAREHOLDERS MANAGEMENT CO., LOS ANGELES, CALIF.

Mrs. WALTER-CARLSON. Senator Hart, I appreciate the opportunity to be here today.

I have been a security analyst for 18 years, beginning my career as a research assistant in 1956. My initial assignment was coverage of the emerging high technology industry, which primarily consisted, at that time, of IBM, General Electric, Westinghouse, and the large aerospace companies.

Ancillary high technology companies emerged, exploded, and expired during that period which produced today's major semiconductor companies such as Texas Instruments, Motorola, and Fairchild Camera and Instrument.

Ten years later, in 1966, I was asked to follow the emergence, explosion, and subsequent expiration of the computer leasing and software companies and the peripheral equipment companies.

I was involved in research and corporate finance work in the high technology area at W. E. Hutton & Co. from 1966 to 1972, and negotiated a sizable merger which was consummated in 1969 involving $200 million in consolidated sales.

For the past 2 years, I have been with an investment advisory firm with over $1 billion in assets under management, including six mutual funds, small individual accounts, and pension fund accounts.

I am vice president and associate director of research and have responsibility for the analysis of companies operating within the entire high technology area, including computers, peripheral equipment, software service companies, semiconductors, electronic instruments, and consumer electronic products.

Because of the information flow from Wall Street and other sources on the major companies we do not personally call on those companies, but direct our efforts to following the small companies which do not receive attention from Wall Street.

In spite of this policy I found that I was not getting objective information from Wall Street during the IBM-Telex trial last year and devoted 100 percent of my time to the reading and analysis of many of the documents which became part of the public record as a result of that trial.

My conclusion led me to recommend the sale of our IBM holdings approximately 1 year ago—August 1973—at a price of about $315 per share. That recommendation was followed and our accounts now have a very small amount of IBM.

Perhaps the most illustrative example of the lack of easily available data to security analysts and manufacturers in the computer industry is a comparison of the annual reports to stockholders of IBM and General Motors, which was selected simply because it is the largest industrial company in the United States.

The IBM report begins with the traditional letter to shareholders, which is 3½ columns long and which contains only four paragraphs of operating statistics, or at most, 10 sentences of text, less than 1 sentence per billion dollars of sales.

That is followed by a financial review which is less than two columns in length. It is basically a terse document designed to conform to the minimum standards for reporting required by the Securities and Exchange Commission and the accounting profession.

It is not in any way helpful in analyzing what occurred in the computer industry during the year.

In summary, IBM, the computer industry leader, provides no industry data either to its shareholders or to investment analysts in its annual report.

In order to illustrate that an industry leader can divulge substantial information I reviewed General Motors latest annual report. The letter to shareholders is two pages long. The body of the report entitled "The Year In Review" provides a wealth of information in approximately nine pages of text plus another nine pages of illustrations.

Excerpts include:

> Of all new cars sold in the United States during 1973, including imports, 45 percent were GM products. Electromotive division sales included 40 high-speed, 3,000-horsepower passenger locomotives, et cetera.

Compare these facts with the most definitive statement in the IBM letter to shareholders, to wit:

> Accompanying a record rate of worldwide installations in the final quarter of 1973, outright purchases of data processing equipment were also at an all-time high for any quarter and were higher for the full year 1973 than for 1972.

The end of the GM annual report provides a 20-year history of operations and includes a 10-year history of the number of cars, trucks, and coaches manufactured in the United States by brand name, and the number of cars manufactured outside the United States by country.

None of this information is available from IBM.

The other computer companies all make an effort to inform their shareholders as to the performance of the several aspects of their business.

NCR has made a successful effort to provide information and has used a question-and-answer format in place of the traditional letter to shareholders.

The questions represent those most frequently asked of management, and the answers are their usual response. The 10-years of operations present detailed information enabling analysts to immediately compute significant financial ratios.

Burroughs' annual report describes each product group's experience in the previous year in some detail. In the case of Control Data the

annual report is concise and does not give as much information as analysts would like to have, but it does divulge sales performance by group in the letter to shareholders.

However, Control Data follows the practice of mailing the complete 10–K report to security analysts as soon as it is available.

Sperry Rand's annual report is also complete and includes a table on revenue and income for its four major product groups for the past 5 years. The 10-year summary is so inclusive that it should probably be adopted by the SEC as mandatory for all companies in all industries.

Honeywell has not made analysis easy in the past, but the 1973 annual report does provide significant information on the revenue stream derived from Honeywell Information Systems and the amount of sales and earnings coming from its other businesses.

What is lacking in the IBM report? The company could employ some simple visual aids such as bar charts or graphs to present data for at least a 5-year period.

Rental and service income and sales should be reported separately; and sales should be broken out between EDP sales and other sales.

The company should provide information as to the breakdown of the various classes of machines shipped and the sales-lease ratio within those classes.

Somewhere in the report management should at the very least comment on the operations of its various divisions. In many ways, the IBM annual report is actually misleading.

For instance, the average shareholder probably looks at the 10-year record and sees a constant uptrend in sales and earnings. If IBM reported the derivation of those sales, the shareholder would see that EDP sales are rising much more rapidly than rental and service income.

If IBM reported domestic and foreign revenues and earnings separately, the shareholders would see that overseas growth has far outpaced domestic growth.

Other industries have substantial statistical data which is reported on a weekly and monthly basis by product. The steel industry reports production figures on a weekly basis; the auto industry reports new car production and sales every 10 days; the consumer electronics industry—radio and television—reports factory production, factory sales, and dealer sales on a monthly basis.

And the home appliance industry reports factory sales monthly.

A trained security analyst uses this data, along with other information, in making investment decisions. Manufacturers use this data to help plan production schedules which in turn provide a key to the proper level of purchasing activity which in turn should reduce the cost of carrying inventories.

There is no such data available on the computer industry with the exception of the International Data Corp. census, which is an estimate of the total number of computers installed.

Since IBM so closely guards its data none of its competitors are willing to release additional industry information.

We do not know the number of various classes of machines shipped monthly, quarterly, or even annually on a total basis; nor do we know by whom.

Of those machines, we do not know how many were leased, how many were outright sales, and how many were third-party leases.

We do not know the configuration of any of those computers, hence we do not know the sales value or the monthly rental which will accrue.

We do not know if the machines shipped were to new users, whether they were upgrades resulting in machine retirements, or whether they are additions.

We do not know whether the machine retirements, if any, were fully depreciated and, if not, whether there are sufficient reserves on the balance sheet to cover necessary writeoffs.

We do not know if these machines are domestic or foreign installations, nor do we have any indication of which industries are increasing or decreasing their installations of machines.

This incredible lack of industry information is one of the major barriers to entry in the computer industry; no reputable financial institution with a fiduciary responsibility, and acting on the prudent man theory, can support a new venture where there is no market information available.

I believe that an initial step in improving competition in the computer industry is the creation of a central reporting organization with the responsibility of collecting data under strict rules of confidence.

Such an organization could be established either as a user group, which would report the installation of a class of computer, whether it was purchased or leased, and the industry classification of the user, or the computer manufacturer who shipped the machine could report the same information to a central reporting organization.

The establishment of such an organization would serve at least four primary purposes: One, competitors would have access to data which showed which industries were increasing or decreasing installations; two, industry would have hard data detailing trends either toward outright purchases or toward leasing; three, small competitors would be able to service only that portion of the industry which constitutes their viable market, outright purchases; and four, a major barrier to entry would be eliminated because financial institutions would have data available indicating market size.

Using other trend-line data, growth rates, and other variables, could be factored into the projections, thereby enabling the lender to determine the total amount of financing required to build a viable business.

The minimum data required should include machine class, average monthly rental, sales value, sale or lease, industry classification of user, domestic or foreign installation, and replacement, retirement, or upgrade. Data should be reported on a monthly basis.

The relative size and strength of IBM compared with the five other main-frame companies is clearly demonstrated by a comparison of financial information taken from their respective latest annual reports and 10–K reports.

In 1973 IBM generated computer-related revenue of $8.7 billion or 64.7 percent of the total computer-related revenue for all six companies of $13.4 billion.

Pretax income from all operations, including noncomputer-related activities, total $3.7 billion for all six companies. Of this amount, IBM reported $2.9 billion, or just under four times the combined pretax income of the other five companies.

In 1973 IBM's research and development expenditures of $730 million was nearly equivalent to the combined pretax income of the other five companies, which totaled $794 million.

In 1973 this $730 million of research and development expense represented 25 percent of pretax income and about 8.5 percent of EDP revenues for IBM.

However, Honeywell's research and development expense of $160 million was 85 percent of pretax income and 13.5 percent of sales.

Sperry Rand spent $146 on research and development, or 69 percent of pretax income and 13 percent of EDP sales.

Clearly, IBM's huge research and development expenditures come not as a result of spending a proportionately higher percentage of income or sales on research and development, but because its massive profit base permits it to do so.

The foregoing statistics indicate that IBM is a self-perpetuating giant with a formidable financial lead over its competitors, and it is this strength in sheer dollars which is the crux of the competitive problem in the industry.

Because IBM has been spending so heavily on research and development, based on its financial ability to do so, the company in the very recent past has gained a technological lead over its competitors.

However, this technology has not immediately benefited the user by reducing his computer costs, nor has it been available to the competition at the same time at which IBM had the technology in house.

IBM has withheld that beneficial technology from the marketplace to protect its rental base until a competitor, whether it be the peripheral equipment companies with a speedier product, a main-frame company with virtual memory, or a semiconductor company with MOS memory, forced IBM to move forward.

This practice has impeded technological progress because none of IBM's competitors can afford to risk the viability of their company on an unproven technique. It is only when IBM bestows its official blessing via the introductory route that competition returns to the marketplace.

If IBM continues to restrain competition by withholding technological advances for its own financial benefit it is possible that the technology which exists in our other main-frame computer companies, which is well advanced from that of foreign competitors, will be exported through foreign investment in those firms.

IBM's research and development activities, while privately financed, have become a national asset. Although the company's scientists present many papers before various professional society meetings, the competitors in the industry do not have the financial wherewithal to pursue a large number of state-of-the-art research activities.

Any restructuring of IBM should therefore direct itself to giving the scientific community an opportunity to have at least limited access to this vast pool of knowledge.

This would actually be a conservation of assets since those with limited resources would not continue to seek a nonexistent light at the end of the tunnel.

The institutional investor has come under attack recently for creating the so-called two-tier market, meaning the acquisition of stocks of those companies which have unblemished earnings records.

These stocks are also referred to as "one decision" stocks, meaning that a portfolio manager buys them, puts them away, and adds to them in market downturns, but never sells them.

One of the reasons for this philosophy is that these companies typically have very large capitalizations and can be purchased in size or in large blocks.

Why the commitment to large capitalization stocks? A portfolio manager generally is responsible for a sizable pool of money, at least $100 million at an institution of any size, which he will invest in 20–30 stocks. His minimum position would therefore be $3 to $5 million, and since it is considered unwise to own a sizable percentage of the market value of a given stock the portfolio manager typically will look only at stocks with total market value in excess of $100 million.

The market capitalizations of a random sample of 20 companies, both large and small, in the overall technology area shows only 11 companies with at least a $100 million capitalization.

The peripheral equipment companies, however, regardless of earnings, all have market capitalization well below the $50 million minimum and only Telex and California Computer are above $20 million.

Obviously, one of the best measures of the value of an investment is the price one pays today for future earnings. The two companies in the peripheral industry with the best records, California Computer and Storage Technology, are selling at five and seven times earnings, respectively, based on last year's earnings.

In both cases earnings are expected to increase this year, so the multiple on future earnings is even lower. Both companies are in need of longer term financing to replace their costly short term bank debt, but are unable to go to the equity market because of the low relative prices of their common stocks. Their debt to equity ratios are already top heavy so that the debt route is closed to them also. The third avenue of cash inflow is also unavailable, and this is private placement of some combination of securities with an institutional investor.

The offering statement for a private placement generally contains more information about future product plans and strategies than the prospectus covering a public offering.

In many cases a 5-year plan is included, estimating contribution to sales and earnings of both existing and planned products.

The peripheral equipment companies are unable to present such a long-range plan very convincingly because of IBM's past practices of introducing phantom machines and/or price reductions in the form of long term leases. Furthermore, the peripheral companies have difficulty in establishing the size of their market because of the lack of information on computer shipments.

The institutional investor has a strong fiduciary responsibility because he is investing funds for others. He must operate under the prudent man theory, for he is legally liable for the loss of those funds.

Based on past experience, prudence dictates that it is unwise to invest in a company which exists only so long as it does not encroach upon IBM's market share.

The institutional investor is unable to invest in the publicly owned common stocks of the peripheral equipment companies because their market values are far too low.

Storage Technology has a market capitalization of less than $30 million and California Computer's market value is just over $21 million. This compares with $29 billion for IBM, $3.4 billion for Burroughs, and almost $2 million for Texas Instruments. The dilemma which we face is that on a multiple basis, California Computer, at 5 times, and Storage Technology, at 7 times, are more attractive than either IBM at 18 times or Burroughs at 29 times earnings. California Computer and Storage Technology are also growing faster than IBM or Burroughs, so if the computer market was truly competitive these two stocks would be selling at a premium. However, investors assume that the computer market is not competitive, and thus, the future of California Computer and Storage Technology is uncertain.

If the competitive question is not resolved quickly the viability of these companies is not assured because of their inability to finance internally-generated, long-term growth.

It is to management's credit that these companies have performed so well in the face of unfair and uncommon competition. As an institutional investor I would like to own California Computer and Storage Technology because I have been given every reason to have faith in management.

Fiduciary responsibility and prudence prevent me from doing so because the risks from outside, uncontrolled forces are too great.

My universe of acceptable investments has thus been curtailed; conversely, the risk of foreign investment in these companies, and consequent export of their technology, has increased markedly.

The management instinct is to survive, and if the only avenue for survival is control from outside the United States then that is the avenue which will ultimately be followed.

The next part of my statement concerns what I consider to be the heart of IBM—its component division.

By way of background: In 1912, in a small house in Palo Alto, Calif., Lee de Forest and his associates started the electronic revolution by perfecting the vacuum tube as a sound amplifier and generator of electromagnetic waves.

In the 1950's, or 40 years after its invention, IBM used vacuum tubes to build its first computer, the 701. It was introduced in 1953.

The next major technological event occurred on December 23, 1947, at Bell Telephone Laboratories. Three distinguished scientists who later won the Nobel Prize for their invention demonstrated the first successful transistor. The inventors were Dr. John Bardeen, Dr. Walter Brattain and Dr. William Shockley, and it is the latter who is the father of the commercial semiconductor industry.

The original Shockley Transistor Corp., backed by Beckman Instruments in 1955, is the direct antecedent of nearly 25 companies in the San Francisco Bay Area.

Shockley Transistor never became the successful commercial venture which its founder envisioned, and was sold by Beckman to Clevite, who sold it to I.T. & T., who was unable to sell it and finally shut it down in 1968.

The eight young scientists who left Shockley and founded Fairchild were responsible over the years from 1959 to let's say 1970 for forming approximately 20 odd companies during that period of time.

They were able to gain financial backing from a variety of sources.

They had no difficulty in doing so. The semiconductor industry is now, and was during that time, a very responsible viable industry growing on a strong technological base.

The transistor was still the dominant device type being built in the early 1960's, although technology was progressing to the point where processes for other types of semiconductors were nearly perfected. This is the primary reason for the number of spinoffs which occurred during this period.

The most successful spinout from Fairchild is Intel, an acronym for Integrated Electronics. Two of the original eight Fairchild founders left Fairchild to pursue the MOS semiconductor memory market, which they believed could shortly become price competitive with ferrite memory cores.

Intel was founded in 1968 with backing from Arthur Rock, the original backer of Max Palevsky of Scientific Data Systems. Five years later in 1973, Intel had sales of $67 million and had successfully perfected the processing techniques necessary to make high-density MOS chips at low cost.

The semiconductor industry debacle of 1970 dried up the stream of venture capital which had supported the startups, and there have not been any new companies formed in the past 3 years.

Texas Instruments has spawned only a few new companies, the largest of which is Mostek. On the other hand, IBM Components Division has spawned only two companies: Cogar, which went bankrupt about 2 years later; and Advanced Memory Systems, which is currently having rather severe problems.

A third spinout, Semiconductor Electronic Memories, has yet to develop significant revenues.

There is a schematic diagram in my prepared statement which shows the genealogy of the industry since its inception in 1947.

So, only three groups have left the IBM Components Division to strike out on their own, and none of them have been successful. The reason, as the following discussion will show, is that IBM's semiconductor expertise lagged the industry until quite recently.

Texas Instruments was one of the 12 original licensees of Bell Telephone Laboratories in 1952 and was in high volume production of germanium transistors in the mid-1950's. In 1954, TI announced the first silicon transistor which was available for certain military programs in 1956.

In 1958 at Texas Instruments, Jack Kilby invented the integrated circuit, and the first were commercially available in 1964.

IBM's first computer, the 701, used vacuum tubes, and that machine was produced until 1959. The 1401 was introduced in 1959 and used germanium transistors, although silicon transistors, which are faster, had been available since 1956.

It is difficult to pinpoint the exact time when IBM decided to go into the components business, but in 1954 research and development expenditures leaped 7 to 8 percent of sales from 3 percent the previous year. Since the computer had been introduced in 1953, and IBM was already planning its next machine, the 1401, we can only assume, that management set up an R. & D. facility in 1954 to pursue the still relatively new transistor technology which was already in volume production on the outside.

Although silicon transistors were available IBM elected to remain with the germanium transistors which it was then producing in-house. IBM's largest outside suppliers were TI and Fairchild, but they were used as second sources to fill gaps in IBM's internal supply lines.

By 1960–61, IBM was in the early design stages of its 360 computer. The heart of this machine was the components.

In spite of the fact that the integrated circuit had been invented at least 4 years earlier, and could easily have been in volume production at IBM and TI and probably Fairchild in 1963, IBM made the decision to use a hybrid circuit which it called solid logic technology—SLT.

SLT was an early form of transistor-transistor-logic—TTL—and was ultimately extremely easy to produce. IBM's organization charts show just how critical these components were. The components division operated semiautonomously until 1963, when the entire division was suddenly pulled under the jurisdiction of Vincent Learson, where it remained until the end of 1966.

IBM stayed with the SLT technology until the introduction of the 370's in 1970, although the independent semiconductor companies had by then introduced many faster and denser devices.

Was IBM cautious or was it deliberately bringing the heart of its machines in-house? We think the evidence shows that the latter answer is correct. If IBM was being cautious it could have selected several of the semiconductor houses which were proliferating in the early 1960's as suppliers, thereby guaranteeing itself at least one second source.

When IBM introduced the first 370 machine in 1970, the circuitry used was another in-house design called monolithic systems technology. However, in 1965 Texas Instruments had introduced the most-successful logic family in the industry, TTL. And, by the time the 370 was introduced, large scale integration was readily available.

The history of the devices used by IBM in the 370's is revealing.

In June 1970 the 155 and the 165 were announced with core memory.

In March 1971 the 135 and 145 were announced with bipolar memory, but in July 1971 the 195 was introduced with the older technology which was core.

In August 1972 IBM announced new versions of the 155 and 165—(which had used core memory—the upgraded 158 and 168, which used MOS memory.

The last two of the 370 machines to be introduced, the 125 in October 1972 and the 115 in June 1973, both use MOS memory.

Again, one might ask if IBM were merely being cautious, and the answer has to be negative.

In 1970 when the first 370 was announced using core memory, several suppliers were already building MOS memories.

In August 1972 IBM announced the upgraded versions of the 155 and 165, which were called the 158 and 168, using MOS memories. Meanwhile, the early purchases of the 155 and 165 with core memories—and there are an estimated 2,000 installations of these machines with monthly rentals of $50,000 to $100,000—were offered the opportunity to upgrade their new but obsolete machines at a cost of about $300,000.

The history of the semiconductor industry introductions and IBM's usage of electronic circuitry is shown in my prepared statement.

Now that IBM has MOS technology perfected it is apparently gaining a technological lead over the semiconductor industry for the first time.

We know from papers delivered to professional meetings that IBM has the capability of building a single 4–K—K is the engineering term for thousand—MOS device, and that it has had some limited success with a 32–K MOS device on a single chip.

The other computer companies will not have this capability for a significant period of time because their suppliers, the semiconductor companies, must make a profit on the components which they produce, and they cannot produce these chips profitably for some time.

In the semiconductor process the most critical factor in profitability is yields, the number of good chips from a wafer, and the most critical factor in good yields is good chip design.

At the present time the semiconductor industry is struggling to produce 4–K MOS parts in quantity, but it is unable to do so because of very low yields, which in turn make the parts too expensive to be cost competitive.

IBM does not have the same cost requirements as do the semiconductor companies because its profits are derived at the system level and the components do not necessarily have to be profitable items when they are first used.

On the other hand the semiconductor companies cannot afford to sell chips to the computer main-frame companies at a loss, even though these chips might make their products more cost effective.

Quoting IBM—exhibit No. 115, page 43, from the IBM–Telex trial:

> * * * The memory technology, phase 21, absorbs about 50 percent of each new build cost, while the MST–2 logic cost accounts for another 25 percent. Both technologies are cost sensitive to quantity variations and yield percentages. The performances of East Fishkill, Burlington, and Endicott CPM are, therefore, as vital to the financial success of the M135 as the effectiveness of Kingston in providing the power and the assembly and test functions. * * *

If, as IBM seems to suggest, 75 percent of new build cost is accounted for by components, then the other computer main-framers are indeed at a great disadvantage, but the reasons are far more complex than just the cost of components.

IBM is quite probably the most profitable semiconductor manufacturer, on an unallocated cost basis, because it does not produce a broad line of circuits; only those which it uses in its own products. Volume is the key to profits in the components business, and IBM clearly has the longest production runs of any of the houses. What other house can run the same product with no iterations 7 days a week for 2 or 3 years?

IBM's research and development activities in the components are also extremely effective because it can allocate all of its expenditures to the improvement of technology for computing uses.

In 1973 IBM spent $730 million on research and development. If 10 percent was spent in the components area, then $73 million was spent on improving components for computer usage.

On the other hand the semiconductor industry spent a total of $150 million on research and development in its four major markets: Government, consumer, industrial, and computers. If those dollars were allocated equally this would mean that 25 percent of the $150 million was

spent on computing uses, or about $38 million, approximately half the amount spent by IBM.

We suspect that IBM spent more than $73 million on components since we have shown how critical they are to the computer business, and I think that the figure was closer to $100 million, or three times the amount spent by the other semiconductor manufacturers for improving computer products.

These figures become even more distorted when one considers that the $38 million spent by the semiconductor industry for computing use was spread among five computer main-frame companies, about a dozen minicomputer manufacturers, and at least 100 other computer-related customers.

IBM has a great advantage because when it begins the design process on a new computer family, all of its needs are available in-house—especially the components.

Perhaps more important than anything else is the absolute secrecy which is maintained internally, because no outsiders need to be involved.

As the above discussion shows, IBM is moving from a follower to a leader in semiconductor technology, and the pace appears to be accelerating so that IBM will clearly be at the forefront in semiconductors for computing usage in a few years.

When Control Data sued IBM part of the relief it requested was that IBM's Components Division be spun out so that the other computer main-framers had the benefits of what was only then beginning to be technical superiority in the semiconductor area.

IBM's semiconductor expertise must be made available to the other computer companies in order to assure future competition. Furthermore, the semiconductor test equipment division must be spun out as well, since it is a necessary adjunct to the use of made-in-IBM components.

The next section deals with some technical terminology with regard to the inability of the semiconductor industry to produce an 8–K or a 16–K MOS memory whereas IBM is currently able to do that. And, then the fact that further on down the road in IBM's FS program—the future systems computer—that IBM may move to another kind of technology which is called "charge coupled devices" or "CCD's." While the other semiconductor houses are working on the CCD's—and I have no doubt that they will be able to produce those in quantity in 1977 or 1978—there is a possibility which nobody knows and which nobody can answer: That IBM in some of its other aspects of the future systems will use something known as bubble memories. The semiconductor companies absolutely will not be able to produce these bubble memories because they have different properties from all other semiconductors and, in fact, they are not a semiconductor. The only other company known to have expertise in producing bubble memories is Bell Telephone Laboratories, and they, also, only produce for in-house use.

I then go through the size of the semiconductor industry which according to various estimates, and the one cited here happens to be RCA, should be in terms of U.S. factory sales—close to a $4 billion industry in 1978. I suggest that if IBM were introduced into the marketplace as a supplier, initially it would acquire some share of the computer business equipment market which would be the memory segment of the semiconductor market.

If we assume that the computer semiconductor memory market expands to $650 million in 1978, and that IBM can capture an unrealistically high 50 percent of that market, then in 1978 IBM would have a 22.4 percent share of the total market for computers and business equipment.

However, that would result in only 8.3 percent of total U.S. factory sales of semiconductors of close to $4 million.

I estimate that IBM Components has total volume of about $600 million, all of which is in integrated circuits.

IBM would therefore be the largest integrated circuit company in the industry, but Texas Instruments, with sales of—and we have to estimate this figure also—about $650 million would still be the top semiconductor in the industry.

Based on some allocations for manufacturing costs, research and development, selling general and administrative expenses, I have calculated that IBM Components would have an operating margin of about the same as Texas Instruments, Fairchild, and Motorola, but lower than the newer, smaller companies in the industry, such as Intel, Mostek, and Advanced Micro-Devices.

In conclusion, I believe that the group of tables which I have shown in the text shows that IBM would be a viable competitor in the semiconductor industry, and that the other companies which now dominate the industry would not be placed at a competitive disadvantage.

Furthermore, the other computer companies would be able to compete much more effectively if they could use IBM's semiconductor memory devices which will surpass those of the independent semiconductor companies in the 1975–76 time frame.

I have not made any attempt to estimate revenues for IBM's test equipment operations, but the total market is probably about $150 to $200 million.

The inclusion of revenues from this source could increase IBM Components Division revenues by as much as $25 million. However, TI and Fairchild also build this type of equipment, but we don't know what their revenues are.

And so we believe that the major companies would probably retain their present competitive characteristics.

The table in my statement shows the profitability of something like IBM Components, Inc., under a number of different assumptions.

Senator HART. That is a most interesting and useful analysis both on computer industry and your lecture on its background. Your prognosis about the future of components in this industry is fascinating.

I know staff has a number of questions on the matter in order to obtain fuller information and data. You suggest some central reporting agency with an obligation of confidentiality to put the data together.

What role would you see of the SEC? Would it be possible for the SEC to do something like that?

Mrs. WALTER-CARLSON. I really feel that's outside the sphere of SEC responsibilities. Several reporting organizations which now exist are independent agencies or corporations.

In fact there are, I believe, profitable corporations such as the central reporting agency for cars and trucks, which is Ward's Automotive Reports.

In the laundry industry there's the Home Laundry Manufacturer's Association; and the Electronic Industries Association, until very recently, compiled data on various kinds of semiconductors which were produced and shipped.

I really think that kind of an organization would work better or be something with which we are more familiar than having it done under SEC jurisdiction.

Mr. NASH. Thank you.

You mention Mrs. Carlson, that you were unable to obtain objective information from Wall Street during the IBM Telex trial last year and you spent a considerable amount of your own time going through the documents.

I would be interested in your perspective of why the lack of available information from Wall Street about this industry and about the entire antitrust litigation going on in the industry.

Mrs. WALTER-CARLSON. Well, there are two things. There are no experts on Wall Street on IBM because we really don't know what goes on in IBM, or we did not until we were able to see the documents which were entered into the public record as part of the IBM-Telex trial.

The second part of your question or second part of my answer to your question—why were we not on the institutional side receiving complete information—I think has to do with the IBM mystique, as it were, which has been built up over so many years. IBM had never lost a case and it could do no wrong and I don't think a lot of the Wall Street analysts were paying a great deal of attention to the odds, if you want to call it that, as to whether IBM would win or lose. The assumption was that IBM has never lost before and so surely they will win and so clearly IBM is a buy and clearly you should own IBM.

There were very, very few people who were willing—and never in print but verbally—to make the statement that there was a possibility that IBM could lose the *Telex* case, but they were hard to find.

Mr. NASH. We have not received many communications in our office—and it's not necessarily expected that we would—but we have not received from Wall Street, or institutional investors for that matter, complaints about lack of information on the computer industry.

Is there any feeling in Wall Street that they would like more information, or are they satisfied to go along with what they have?

Mrs. WALTER-CARLSON. No. I think Wall Street is dissatisfied with the amount of information available on computer placements, computer installations, and that kind of thing.

I think it reflects in the prices of the other stocks in the computer industry. The institutional investor with a fiduciary responsibility does not want to invest in a company where he knows that that company has a limited market share, but really what is that market share.

I mean, we're told by IDC, as a result of its census figures, that we think that Burroughs' share is 10 percent, but we don't really know that.

There's only one company who really knows what the market shares are of itself and everybody else, and that's IBM. And they're not willing to indicate what their share is. Therefore, the other companies are certainly not willing to indicate that perhaps their share is even less than what the IDC census shows. We just don't know that.

Mr. NASH. How does IBM react—or other institutions heavily invested in IBM—when brokerage firms might put out negative comments about the stock? Do you see any problems about that?

Mrs. WALTER-CARLSON. Oh, there could be some problems. I don't know that they've really occurred, but the Wall Street brokerage firms right now are in severe financial difficulty, as we know, and I would think that they would not typically want one of their analysts testifying against IBM, or taking a position against IBM, or recommending sale of IBM because it would undoubtedly upset some of their major accounts which pay out a great deal of gross in commission business.

Mr. NASH. When you say "upset a great deal of their accounts," what type of accounts do you mean; institution accounts, insurance companies?

Mrs. WALTER-CARLSON. Yes.

Mr. NASH. In your statement you say:

> Based on past experience, prudence dictates that it is unwise to invest in a company which exists only so long as it does not encroach upon IBM's market share.

How sure are you that the problems confronted by those companies are not inefficient management or poor quality products, higher prices, or other internal problems?

Mrs. WALTER-CARLSON. Well, let me give you a personal example of what I mean here. In 1973, early 1973, on my recommendation we owned a fairly sizable block of Storage Technology, and Storage Technology we knew to have good management. After all, they had grown in the face of adversity; they had been able to raise money up until that time; and they had just announced that they were going to do an offering to raise additional money. Shortly after that a rumor got started that IBM was about to announce a new tape drive which Storage Technology did not have, and in a manner of a couple of trading hours that day, Storage Technology, which had been trading at about $17 or $18 a share, went down to $9 or $10. There was no reason for it because nothing had changed, really, within the company in terms of what they were going to earn in the current quarter or in the next quarter. But the fright was that IBM was coming out with a product which Storage Technology would not be able to produce and the company would be hurt financially.

As a direct result of that rumor, which didn't turn out to be fact until about 6 or 7 months later—well, fact in terms of IBM actually introducing that product which Storage Technology could also produce and which it then did produce—we saw our investment cut in half in a couple of hours. I could never, at this time, take a recommendation of a Storage Technology, or a California Computer, or one of those companies, to our investment management committee because the first thing they would say to me would be remember what happened when we owned Storage Technology.

Mr. NASH. The way I read your historical tracing of the semiconductor industry, it seems to me as if the development of the semi-

conductor industry is almost said to be synonymous with the development of the computer technology in that semiconductor seems to be the heart of the computer.

I would like your reaction to that.

Mrs. WALTER-CARLSON. This has become much more true with the advent of the integrated circuit than it was while transistors were in existence.

First of all, there just aren't that many different ways that a transistor can be manufactured because it's small-scale integration and it's typically a single unit. So when transistors were being used in all computers it really didn't matter because Honeywell or Sperry—or even GE or RCA at that time—were still in the business, and could call Fairchild or Texas Instruments or Motorola or National Semiconductor and say send me 1 million transistors and that's what they got. They were basically configured in the same manner and the computers came out and they kind of all looked the same.

Well, when you became involved in integrated circuitry, which is when IBM began to bring its components division strictly in-house, then the semiconductor manufacturer, who is supplying the heart of the machine, really becomes in part the designer of your system. However, when you're going on the outside, obviously there are nondisclosure agreements which are signed so that the information doesn't get traded between competitors.

But, you are at a disadvantage because you say to your supplier, "Well, now, you're telling me that you're going to be able to manufacture this memory device and you will absolutely ship it to me in September 1973." This, in fact, happened, and then the semiconductor industry found out that they couldn't make 4–K devices and IBM found out that they could not make 4–K devices. But IBM, because their components were internal, were able to substitute a package, a module, of four 1–K devices on a single substrate until they were able to produce the 4–K. It did the same thing except the 4–K ultimately will be cheaper than four 1–K's. They could do that because they didn't have any design in timelag because they had always designed around the 4–K.

On the other hand the other computer manufacturers couldn't do that because they were waiting for the 4–K, and maybe they had left only the amount of space for that package in their machine and then they couldn't get one 4–K. They had to take four 1–K parts and their equipment was delayed because they couldn't redesign the entire box to contain the extra components.

Mr. NASH. Would it be fair to say that significant advances in computer industry technology have been made by semiconductor companies rather than computer companies themselves?

Mrs. WALTER-CARLSON. Absolutely. The semiconductor companies have been extraordinarily responsive to their customers needs. They have worked directly with the customer. They've tried to design around the problem. The semiconductor manufacturers, in fact, really attempted to get the—well, not the main-frame computer houses because it was too late in their design cycle to shift—the minicomputer manufacturers to go to MOS memories long before IBM introduced the upgraded 158 and 168 equipment with MOS memories. Those little minicomputer companies just were afraid to do it because they couldn't

take the chance on the viability of their company by introducing a new technology.

It was not until IBM did announce the upgraded 158 and 168 that there was a run on the semiconductor industry for MOS memories. They didn't have enough plant and capacity in place and they couldn't ship as quickly as their customers would want.

Mr. NASH. That's the point you made, I believe, when you indicated that in August of 1972 IBM announced upgraded versions of certain machines using upgraded memories.

You referred to IBM's technology and offering new but obsolete machines at a cost of $300,000. My question relating to that is, and I just want to bring out for the record to make sure I read it properly, is this one of the examples you had in mind when you indicated IBM selling outmoded technology or better technology existing but not being accepted in the marketplace because it is not yet utilized by IBM?

Mrs. WALTER-CARLSON. Yes. I think, as I also pointed out in the text of my testimony, IBM was really very late in developing an expertise in the semiconductor technology.

In fact, they used very, very simplistic devices when there were many, many more complicated things available.

We think—and we don't know this because nobody really knows a lot of the answers to what IBM does—that when IBM introduced the 370, that they really planned to use all MOS memories.

But MOS is a different kind of processing technique from bipolar, which is what IBM had used in the past. Many of the new companies which started to produce MOS devices never made it because it's tough and it's different to do. We think that the reason why IBM held off until August of 1972 and then announced an upgraded version of the machine which had only been out for 18 months was because they simply could not produce the devices. It was only when they could produce the devices in quantity that they served themselves by introducing the new machines, to the detriment of the user.

Mr. NASH. In reviewing whether an industry structure is good or bad many people ask the effect on the user. Is the user paying higher or lower prices than otherwise? Do you have any suggestions to us as to how we could attempt to quantify the costs to users from the type of technological hold-back you have been referring to?

Mrs. WALTER-CARLSON. I'm really not sure that I can answer that question. I don't mean to avoid it but I'd have to go around it a little bit because I can't answer it directly.

When a semiconductor part is introduced for the first time it is extremely expensive. It is not cost-competitive with whatever has been in the field which is being produced in great quantity because the companies are not yet down the learning curve and they don't have their processing techniques in place and so on.

A 4–K memory right now has an average selling price of $14. I think that within 12 to 18 months that average selling price will be somewhere between $3 and $4, and I can't come any closer than that.

The semiconductor companies have to maintain those high prices until they start making a profit. That delays the main-frame companies from designing those parts because they're too expensive, and that raises the cost of their equipment.

IBM, on the other hand, doesn't have any of those problems. They don't really care, initially, whether the part costs $14 or $4 because they can change the pricing within the various aspects of the system so that they're getting the overall profit margin that they want. When the cost of the components comes down to a justifiable level they can reduce the price of the memory, because that's where the components are going.

But because of the economics involved, that equipment has already been shipped and is already in place and has been generating revenue over that period of time for IBM as a total unit.

Mr. NASH. You seem to be saying that as to the future the market control will be predicated upon component technology and utilization of the IBM Component Division.

Am I on the right track?

Mrs. WALTER-CARLSON. Yes.

Mr. NASH. We would be interested in receiving for the record your recommendations as to what you believe the critical steps might be to create a viable competitive computer industry in the 1970's, 1980's, and so on.

Mrs. WALTER-CARLSON. Well, I don't really think that I have any better answer than anybody else in that regard. I do feel that, as my paper shows, the expertise in the components area, which is very recent for IBM—I mean, after all, we're talking about August of 1972, so that's only occurred within the last 2 years—has got to be made available to the rest of the industry; and I think that will help.

It will help in two ways. It will reduce IBM's in-house lock on secrecy, which none of the other houses have, and it will also permit the other houses to have superior components available to them, because with that technological lock, along with the capital lock, and the software lock, it pretty well means that nobody gets into the business; and an awful lot of people who are in the business probably don't get to stay very much longer.

I think another thing that has to happen is that you somehow or other have to set up a GMAC of sorts with IBM's incredible amount of cash. I think in something which they call "securities held for repayment of long-term debt" they have $3.3 billion in cash, in comparison with $26 million for Sperry Rand.

I mean it's just incredible. That's got to be made available somehow or other to not the other main-frame companies but to the industry as a GMAC and I think one of the other things that you have to do is you have to say IBM for *x* number of years—and whether that's 4 years or 5 years or however long—may not lease; they must only sell their equipment.

That, then, permits the other companies who have been trying to build a lease base on which they have been losing money to also compete fairly, because then they can go out and they can say we only want to sell you equipment because that's all that IBM does and that is now the standard in this industry rather than a risk-lease basis.

Mr. NASH. Thank you very much.

Senator HART. Mr. Granfield?

Mr. GRANFIELD. I'll be brief as possible. I find your statement extremely interesting; and also let me extend a greeting to you.

I spent the last 6 years at UCLA and you make me feel somewhat nostalgic for those beautiful surroundings which you find in your city.

I find your statement interesting because most of the witnesses today have given evidence that IBM is indeed a sluggish monopolist because they lag in the introduction of certain technological innovation.

This morning I tried to shed some light on the whole area of technology, technology not only in the technical but in a cost sense and that may explain some of the technological innovative behavior of IBM vis-a-vis its competitors.

But this afternoon you tell me that IBM is even sneakier than that, that what they have done while they have "lagged" traditionally in the introduction of technological innovations is suddenly achieved such a technical superiority in terms of semiconductors that we shouldn't break IBM up or force it to divest itself of one of its branches because it's a sluggish monopolist and denies its customers technological innovations but because it's going to out-innovate its competitors.

So I'm becoming a little mystified as to exactly what is the implication of somehow affecting the structure of IBM.

Some witnesses tell us because they lag behind. You come and tell us, "Well, they have perhaps traditionally lagged behind; suddenly now they're going to leap so far ahead that this is why we must curb IBM."

So I find your testimony quite interesting because suddenly the sluggish monopolist is going to lead the pack and that's why they are a threat to the competitive liability of the computer industry.

The witnesses to date have told us the great threat they pose to the customers because of their technological rapidity.

Perhaps they listened to these witnesses. I don't know. But I certainly am very uneasy with whatever path is or whatever welfare costs that preserving IBM is going to impose upon its customers or upon the computer public as a whole because you tell me in your testimony that because they have taken the technological role internal to the firm they may be able to out-innovate firms whose primary purpose is the production of semiconductors.

This seems to me a direct benefit of the IBM structure, that they would be able to specialize in the production of semiconductors for information processing for computers.

Could you shed some light on my mystification?

Mrs. Walter-Carlson. Well, that was a multifaceted statement, and I'm not sure that I know precisely what your question was.

Mr. Granfield. Really what I'm trying to home in on is, "Is IBM bad because it doesn't innovate, or is it bad because it does innovate, or is it bad at all?"

Mrs. Walter-Carlson. Well, first of all we're talking about two different time frames. We're talking about what happened before the Justice Department and the other people sued IBM on the basis of antitrust.

I think it is a fact that since the Justice Department suit was instigated IBM has become far more predatory in its acts than it had been in the past, so there is a rhetorical question.

If the sleeping giant was, in the past, able to lead the industry and get along with what it had and continue to reap the benefits of its huge revenue base and not need to innovate, that's one facet.

If, on the other hand, you are under attack because you have not led as the leader in the industry in technological innovation and you are faced with possibly being restructured or broken up or having something done to you that you don't really care to have happen, then you have to take another tack.

And I think that it was sometime in 1971 or 1972—I can't pinpoint the date for you—that IBM determined that that tack was going to be technological leadership.

It clearly did not have it prior to that time.

Mr. GRANFIELD. Well, it seems like IBM is going to be damned if they do and damned if they don't.

Mrs. WALTER-CARLSON. Well, maybe when you get to be that size, relative to everybody else, that's true.

Mr. GRANFIELD. Given this forecast—you saw this tremendous technological breakthrough of IBM—why did you sell IBM stock? Why did you recommend to your firm to sell IBM stock?

Mrs. WALTER-CARLSON. Well, unfortunately, the mutual fund industry—and my own job, in fact—is really a perform-or-perish kind of situation and one does not perish if one manages to outperform what the stock averages are doing. I was under the impression that with IBM under legal attack and with at least a possibility that they would lose the Telex suit, that the stock would not go up; that it would go down. So it was really a simplistic decision that I wanted to retain the assets that we had under management if possible.

Mr. GRANFIELD. Why didn't you sell short?

Mrs. WALTER-CARLSON. Mutual funds can't go short or I would have.

Mr. GRANFIELD. Touché.

One last thing. You said you gave evidence earlier that IBM lagged behind in a very technical way in which they built their memory units.

Are you aware that they lagged behind in total service cost to customers because of changing their information of core knowledge?

Mrs. WALTER-CARLSON. That's what I was about to say. They have, for all practical purposes, a bundled pricing, and you get lots of things free. I don't know what their service costs are.

I question whether anybody outside of IBM knows the answer to that.

Mr. GRANFIELD. Well, what I'm saying is that even though you claim they lag in this technology, and of course, now they will soon be the superman of technology in the field, I would expect the customers to switch to somebody else if they could no longer produce the total project, which is more than the technical capability.

For example, when you innovate and take on semiconductor memory units, if you cannot operate that unit at a certain load of level your costs are very much higher than previous technology.

Mrs. WALTER-CARLSON. Semiconductor core, which——

Mr. GRANFIELD. You were talking about the way IBM has traditionally lagged behind some of its competitors in terms of the potential way they could have built the main-frame units.

Now, as a computer user, when you change this technology, the planners of that computer system, we have been led to believe, had

better forecast capacity acutely because downtime on more complex machines is more costly than on less-complex machines.

Mrs. WALTER-CARLSON. OK.

Mr. GRANFIELD. When you go to more complex machines, since it is much more efficient, if you haven't got that increased capacity, or cannot rent it out, that machine could cost the customer more in the total sense and maybe that's why their customers didn't have the capacity to use this new technology efficiently.

Is that not possible?

Mrs. WALTER-CARLSON. Well, anything is possible; but I don't think it's really realistic. The customer typically knows how many bits of memory he can use and he knows what the cost tradeoffs are.

Mr. GRANFIELD. Well, let me indicate an antidote. At UCLA, when we switched from IBM systems to the 360/91 our computer costs went considerably up.

The reason was we were using that machine only to 45 percent of its capacity. Now, for any program that went through that machine it was much more efficient in the process than with the prior system we had.

Even though we projected a greater increase in use that was not forthcoming, our total cost of operating that system was considerably higher than the prior system we had, yet for any one program the cost was much greater with the new equipment.

Mrs. WALTER-CARLSON. Well, that's exactly what happened in 1970 when all of the computer companies ran into difficulty.

The problem was that most of the users had too much computer capacity already on hand.

Mr. GRANFIELD. What I'm saying is that there might be some rationale for IBM's behavior of serving the customers from a cost-efficiency view. Thank you, Mr. Chairman.

Senator HART. Thank you very much.

[The following was received for the record:]

MATERIAL RELATING TO THE TESTIMONY OF MARILYN WALTER-CARLSON

Exhibit 1.—*Prepared Statement of Mrs. Walter-Carlson*

PREPARED STATEMENT OF MARILYN WALTER-CARLSON, VICE PRESIDENT AND ASSOCIATE DIRECTOR, RESEARCH SHAREHOLDERS MANAGEMENT CO., LOS ANGELES, CALIF.

I have been a security analyst for 18 years, beginning my career as a research assistant in 1956 at Smith, Barney & Co., a major Wall Street brokerage concern. My initial assignment was coverage of the emerging high technology industry, which primarily consisted of IBM, General Electric, Westinghouse, and the large aerospace companies. The big news in 1956 was the IBM–Justice Department consent decree. Ancillary high technology companies emerged, exploded and expired during the 1959–1964 period, which was an exciting time in the electronics industry. This period produced today's major semiconductor companies such as Texas Instruments, Motorola, and Fairchild Camera and Instrument, and super growth companies in the instrumentation area such as Hewlett Packard, Perkin-Elmer and Tektronix. Virtually all of these companies were and still are dependent upon the computer industry in varying degrees.

Ten years later, in 1966, I was asked to follow the emergency, explosion, and subsequent expiration of the computer leasing and software companies and the peripheral equipment companies. Many investors made large sums of money from these companies, but that was when venture capital was available and the stock market was going up. I was involved in research and corporate finance work in the high technology area at W. E. Hutton & Co. from 1966 to 1972 and negotiated a sizeable merger which was consummated in 1969 ($200 million in consolidated sales).

For the past two years I have been on the "other side of the Street" with an investment advisory firm, Shareholders Management Company, with over $1 billion in assets under management, including six mutual funds, small individual accounts, and pension fund accounts. I am Vice President and Associate Director of Research and have responsibility for the analysis of companies operating within the entire high technology area, including computers, peripheral equipment, software service companies, semiconductors, electronic instruments, and consumer electronic products. These are all industries which I have researched intensively in the past, and which I now cover with the aid of Wall Street analysts. Since Shareholders is a sizeable account for the Wall Street brokerages, we receive inputs from all major houses with oral access to their analysts. Because of the information flow from Wall Street and other sources on the major companies we do not personally call on those companies, but direct our efforts to following the small companies which do not receive attention from Wall Street.

In spite of this policy, I found that I was not getting objective information from Wall Street during the IBM–Telex trial last year, and devoted 100% of my time to the reading and analysis of many of the documents which become part of the public record as a result of that trial. My conclusion led me to recommend the sale of our IBM holdings approximately one year ago at a price of about $315 per share. That recommendation was followed and our accounts now have a very small amount of IBM.

My biography is carried in Who's Who of American Women; Who's Who in the West, and Who's Who in Finance.

The subject matter of my statement to this subcommittee today deals with:

1. The lack of available data on this burgeoning industry, vis a vis, others such as steel, autos, and consumer durables.

2. The sheer size of IBM relative to the five other computer companies with some simple supportive statistical data.

3. The difficulties an institutional investor faces with regard to investing in companies allied to the technology field.

4. A detailed discussion of the very heart of IBM—its Components Division—in comparison with the semiconductor industry.

5. Possible effects on the semiconductor and computer industries of a spin-off of IBM Components and test equipment activities.

PART I.—LACK OF INDUSTRY DATA

Perhaps the most illustrative example of the lack of easily available data to security analysts and manufacturers in the computer industry is a comparison of the annual reports to stockholders of IBM and General Motors, which was selected simply because it is the largest industrial company in the United States. The IBM report begins with the traditional letter to stockholders, which is three and one-half columns long and which contains only four paragraphs of operating statistics, or at most ten sentences of text, less than one sentence per billion dollars of sales. The body of the report consists of sixteen pages of pictures interspersed with brief comments on various people, computer applications, new products, and new markets. None of this information is useful in either the financial or product analysis of IBM since it is not specific. The next feature of IBM's annual report is a financial review less than two columns in length, partly repeating the information given in the letter to stockholders, and then repeating the figures given in the income statement which is on the facing page. This is followed by a very brief balance sheet with no footnotes except for the standard notation that "the notes on pages 25 through 27 are an integral part of this statement." The source and application of funds and three pages of brief footnotes are followed by a concise ten year summary of operations, a list of the divisions and their primary focus, and the officers and directors of the company. It is a terse document designed to conform to the minimum standards for reporting required by the Securities and Exchange Commission and the accounting profession. It is not in any way helpful in analyzing what occurred in the computer industry during the year.

In summary, IBM, the computer industry leader, provides no industry data either to its shareholders or to investment analysts in its annual report. A study of the 10–K report reveals some additional information, but a paucity of hard data exists for IBM, and thus for the computer industry as a whole.

In order to illustrate that an industry leader can divulge substantial information, I reviewed General Motors' latest annual report. A preliminary black and white copy is sent to those on the mailing list but is available upon request

to anyone. This advance copy is 50 pages long, compared with IBM's final report of 32 pages. GM's letter to shareholders is two pages long and generally discusses the environment in which the corporation operated in the previous year. There is a cautious statement of expectations for the current year. The body of the report, entitled "The Year in Review" provides a wealth of information in approximately nine pages of text plus another nine pages of illustrations. Excerpts include: "GM's 1973 factory sales of cars and trucks in the United States totaled a record 6,512,000 units, 5,251,000 cars and 1,261,000 trucks * * *. Of all new cars sold in the United States during 1973, including imports, 45.0% were GM products * * *. In 1973, GM had record sales of commercial nonautomotive products in the United States totaling $1.9 billion, or 14% above the 1972 level * * *. Electromotive Division * * * sales included 40 high-speed 3,000 horsepower passenger locomotives to Amtrak, with 110 similar units to be delivered in 1974 * * *. Export deliveries of locomotives during 1973 were up 19% * * *. Compare these facts with the most definitive statement in the IBM letter to shareholders, to wit: "Accompanying a record rate of worldwide installations in the final quarter of 1973, outright purchases of data processing equipment were also at an all-time high for any quarter, and were higher for the full year 1973 than for 1972 * * *. Orders for IBM equipment and services during 1973 continued strong, and at year end the backlog of orders was higher than at year end 1972 despite a record level of shipments" * * *.

GM's very detailed review of the prior year's activities is followed by an eight-page special report on the GM Proving Grounds, a two-page financial review, footnoted income and balance sheets and six pages of footnotes, including a full balance sheet for General Motors Acceptance Corporation. The end of the annual report provides a twenty-year history of operations and includes a ten-year history of the number of cars, trucks and coaches manufactured in the United States by brand name, and the number of cars manufactured outside the United States by country. Expert security analysts who follow GM closely tell me that the Shareholders Relations Department will provide them with various brochures on the advances in engines, the latest in pollution control devices, etc. In addition, the GM security analyst contact will provide the number of cars shipped by division on a ten-day basis to any analyst astute enough to inquire.

The other computer companies all make an effort to inform their shareholders as to the performance of the several aspects of their businesses. NCR has made a successful effort to provide information and has used a question and answer format in place of the traditional letter to stockholders. The questions represent those most frequently asked of management and the answers are their usual response. The financial section of the report shows numerically and graphically the revenue derived in three new product groupings and compares that information with what was reported in 1972 in the four former product groupings. Four bar charts are used to display the number of employees, revenue per employee, consolidated revenues (broken down between domestic, foreign and totaled), and equity per common share for five years, with the exact number given for each entry. The footnotes are descriptive and written in understandable language for the benefit of the stockholder rather than to satisfy legal requirements. The ten-year review of operations presents detailed information enabling analysts to immediately compute significant financial ratios.

Burroughs' annual report describes each product group's experience in the previous year in some detail. A saparate page in the report discloses product revenues for each of four classes of products, and under the equipment and systems classification, discloses the amount of revenue by size of computer: small application machines, small computer systems and business minicomputers, and large and medium computer systems. A separate bar chart gives the sales/lease relationship of the equipment and systems revenue for the past five years. As is the case with NCR, Burroughs' ten year financial summary is very detailed and helpful. There is very little reason to have to dig into the 10–K report to better understand the financials of the company.

In the case of Control Data, the annual report is concise and does not give as much information as security analysts would like to have, but it does divulge sales performance by group in the letter to stockholders. However, Control Data follows the practice of mailing the complete 10–K report to security analysts as soon as it is available (shortly after the annual report is received); this is a very complete document indeed, both on its own merits and especially in comparison with the IBM 10–K.

Sperry Rand's annual report is also complete and includes a table on revenue and income for its four major product groups for the past five years. Manage-

ment is specific in terms of detailing square footage of plant and number of employees by product line which aids in analysis of the contribution to profits by group in the future. The ten year summary is so inclusive that it should probably be adopted by the SEC as mandatory for all companies in all industries.

Honeywell, the second largest computer company, has not made analysis easy in the past, but the 1973 annual report does provide significant information on the revenue stream derived from Honeywell Information Systems, and the amount of sales and earnings coming from its other businesses. We suspect that General Electric, the largest single holder of Honeywell as a result of the sale of its computer operations to Honeywell, might have been instrumental in this shift, since as long ago as 1960 GE has been presenting a breakdown of its product groups in the annual report to shareholders.

What is lacking in the IBM report? The company could employ some simple visual aids such as bar charts or graphs to present data for at least a five year period. For example, a bar chart showing sales and earnings for domestic and foreign operations for the past five years would clearly indicate the faster growth of the overseas operations during this period. Rental and service income and sales should be reported separately and sales should be broken out between EDP sales and other sales since IBM also sells other products such as typewriters. The campany should provide information similar to that presented by Burroughs as to the breakdown of the various classes of machines shipped and the sales/lease ratio within those classes. Somewhere in the report management should at the very least comment on the operations of its various divisions, and ideally, report revenues and pretax profits for its five major divisions: Office Products, General Systems, Federal Systems, Information Records and Data Processing. At present, research and development expenditures are available only in the 10–K whereas the other companies display these expenditures prominently somewhere in the annual report.

In many ways the IBM annual report is actually misleading. For instance, the average shareholder probably looks at the ten year record and sees a constant uptrend in sales and earnings. If IBM reported the derivation of those sales, the shareholder would see that EDP sales are rising much more rapidly than rental and service income. If IBM reported domestic and foreign revenues and earnings separately, the shareholder would see that overseas growth has far outpaced domestic growth. In short, we in the investment community do not believe that IBM presents its financial information as fairly as it could. The reasons for this are unknown, but it is apparent that IBM is intent upon keeping the mystique which it has carefully cultivated for many years.

Other industries have substantial statistical data which is reported on a weekly and monthly basis by product. The steel industry reports production figures on a weekly basis, the auto industry reports new car production and sales every ten days, the consumer electronics industry (radio and television) reports factory production, factory sales and dealer sales on a monthly basis, and the home appliance industry reports factory sales monthly. Until recently, the semiconductor industry, through the auspices of the Electronic Industries Association, reported monthly orders and monthly shipments of semiconductors by device type. A trained security analyst uses this data, along with other information, in making investment decisions. Manufacturers use this data to help plan production schedules which in turn provide a key to the proper level of purchasing activity, which in turn should reduce the costs of carrying inventories. The data is not only helpful to competing manufacturers, but to suppliers as well; if the steel industry sees that the auto companies are planning on increasing production, the steel industry can better gauge its near term demand from this class of customer. If the semiconductor industry knows that inventories of television sets are at very high levels, it can surmise that demand for the device types used in the production of consumer electronics products will slacken, and thus revise its planned production schedules for those particular devices.

There is no such data available on the computer industry, with the exception of the International Data Corporation's census, which is an estimate of the total number of computers installed. Since IBM so closely guards its data, none of its competitors are willing to release additional industry information. We do not know the number of various classes of machines shipped monthly, quarterly, or even annually on a total basis, nor do we know by whom. Of those machines, we do not know how many were leased, how many were outright sales, and how many were third party leases. We do not know the configuration of any of those computers, hence, we do not know the sales value or the monthly rental which will accrue. We do not know if the machines shipped were to new users, whether they

are upgrades resulting in machine retirements, or whether they are additions. We do not know whether the machine retirements, if any, were fully depreciated, and if not, whether there are sufficient reserves on the balance sheet to cover necessary writeoffs. We do not know if these machines are domestic or foreign installations, nor do we have an indication of which industries are increasing or decreasing their installations of machines.

This incredible lack of industry information is one of the major barriers to entry in the computer industry, no reputable financial institution with a fiduciary responsibility, and acting on the Prudent Man theory, can support a new venture where there is no market information available. The would-be competitor must define an area where he has ascertained a possible need for his potential product which must be either cheaper or technologically superior. He must then locate that market which, in the case of the computer industry, is probably confined to users of machines which were purchased outright. That in itself is quite a task, and creates another barrier to entry because a marketing force is expensive to build and maintain with no revenue stream.

I believe that an initial step in improving competition in the computer industry. Such an organization could be established either as a user group which would report the installation of a class of computer, whether it was purchased or leased, and the industry classification of the user, or the computer manufacturer who shipped the machine could report the same information to a central reporting organization. The establishment of such an organization would serve at least four primary purposes:

1. Competitors would have access to data which showed which industries were increasing or decreasing installations.

2. Industry would have hard data detailing trends either toward outright purchases or toward leasing.

3. Small competitors would be able to service only that portion of the industry which constitutes their viable market, outright purchases.

4. A major barrier to entry would be e'iminated because financial institutions would have data available indicating market size. Using other trendline data, growth rates and other variables could be factored into the projections, thereby enabling the lender to determine the total amount of financing required to build a viable business.

The minimum data required should include machine class, average monthly rental, sales value, sale or lease, industry classification of user, domestic or foreign installation, and replacement, retirement, or upgrade. Data should be reported on a monthly basis.

PART II.—COMPARISON OF IBM WITH OTHER MAINFRAME MANUFACTURERS

The relative size and strength of IBM compared with the five other mainframe companies, Sperry Rand (Univac), Honeywell, National Cash Register, Burroughs, and Control Data, is clearly demonstrated by a comparison of financial information taken from their respective latest annual reports and 10-K reports. Data on revenues, incomes, research and development expenditures, net computer rental base, number of employees, and selected balance sheet items are summarized in Table I at the end of this statement. These simple statistics are presented merely to emphasize the great disparity in the sizes of the six primary companies in the computer industry.

Of primary interest in Table I are the revenues generated by each firm's computer business, labeled "EDP Revenue Only," and the installed computer rental base net of accumulated depreciation, labeled "Net Computer Rental Base." In 1973 IBM generated computer-related revenue of $8.7 billion, or 64.7 percent of the total computer-related revenue for all six companies of $13.4 billion. Four of the other five companies generated computer-related revenues of around $1.0 billion in 1973, while National Cash Register generated about $550 million. The disparity in net computer rental base among the companies is even wider, although IBM maintained approximately the same ratio, or 65.1 percent of the total of $5.8 billion of installed computers. IBM's net computer rental base at the end of 1973 was $3.7 billion, compared with $816 million for Honeywell, and $469 million for Burroughs. However, these figures are not really indicative of the number of machines installed, nor of thhe installed base, which is estimated at about $30 billion. Since depreciation practices vary for each company, IBM's net rental base is understated because of its extremely conservative accounting relative to Burroughs with its more liberal accounting. In any case, both IBM's EDP revenue and net computer rental base in 1973 were almost double that of

the other five computer companies combined. These comparisons are shown graphically in Figure I at the end of this statement.

Pretax income from all operations including non-computer related activities totaled $3.7 billion for all six companies (see Figure 2). Of this amount, IBM reported $2.9 billion, or just under four times the combined pretax income of the other five companies. Even more striking is the fact that IBM's pretax income was almost 14 times that of the second largest company, Sperry Rand, while its total revenue was only 4 times as large. Obviously, IBM is the most profitable in the industry, and this is evidenced by the fact that while its total revenues, including EDP, were about 55 percent of the combined companies, its pretax income was proportionately much higher—79 percent of the total. Similar comparisons could be drawn for net income also, as shown in Table I.

Figure 3 portrays research and development expenditures for each of the six mainframe companies, and again the disparity in size is most apparent. In 1973, IBM's research and development expenditures of $730 million was nearly equivalent to the combined pretax income of the other five companies combined, which totaled $794 million. IBM's $730 million expenditure for research and development represented one and a half time the total amount spent by the other five companies, and was 61 percent of the total spent by all six companies. However, if we compute the percentage of pretax income each company allocates to its new product development programs, an entirely different picture emerges. In 1973, IBM's $730 million R. & D. expense represented 25 percent of pretax income and about 8.5 percent of EDP revenues. Honeywell's R. & D. expense of $160 million was 85 percent of pretax income and 13.5 percent of sales. Similarly, Sperry Rand spent $146 million on R. & D., or 69 percent of pretax income, and 13 percent of EDP sales. Clearly, IBM's huge R. & D. expenditures come not as a result of spending a proportionately higher percentage of income or sales on R. & D., but because its massive profit base permits it to do so.

IBM's relative size is further underscored by reference to its net worth, or shareholders equity, which was $8.8 billion at the end of 1973. This amount is about 66 percent of the total net worth of all six companies, and nine times that of each of the next two largest firms, Sperry Rand and Burroughs. Furthermore, IBM's cash and equivalent of $3.8 billion (including about $500 million of securities "held for repayment of long term debt") is only 20 percent less than the combined shareholders equity of the other five companies. A comparison for IBM's cash and equivalent and those of the other companies is shown in Figure 4 at the end of this statement.

The foregoing statistics indicate that IBM is a self-perpetuating giant with a formidable financial lead over its competitors, and it is this strength in sheer dollars which is the crux of the competitive problem in the industry. Because IBM has been spending so heavily on research and development based on its financial ability to do so, the company in the very recent past has gained a technological lead over its competitors. However, this technology has not immediately benefitted the user by reducing his computer costs, nor has it been available to the competition at the same time at which IBM had the technology in-house. IBM has withheld that beneficial technology from the marketplace to protect its rental base until a competitor, whether it be the peripheral equipment companies with a speedier product, a mainframe company with virtual memory, or a semiconductor company with MOS memory, forced IBM to move forward. This practice has impeded technological progress because none of IBM's competitors can afford to risk the viability of their company on an unproven technique. It is only when IBM bestows its official blessing via the introductor route that competition returns to the marketplace.

If IBM continues to restrain competition by withholding technological advances for its own financial benefit, it is possible that the technology which exists in our other mainframe computer companies, which is well advanced from that of foreign competitors, will be exported through foreign investment in those firms. This has already occurred in a roundabout manner with the acquisition of Bull by GE and then the subsequent merger of GE and Honeywell and the intensive amounts of investment in Honeywell-Bull by its U.S. parent. Another example of the export of U.S. technology was the inability of Amdahl to raise sufficient capital domestically to bring its new computer to market and the subsequent majority position gained by Fujitsu and Nixdorf through their infusions of cash.

IBM's research and development activities, while privately financed, have become a national asset. Although the company's scientists present many papers

before various professional society meetings, the competitors in the industry do not have the financial wherewithal to pursue a large number of state of the art research activities. Any restructuring of IBM should therefore direct itself to giving the scientific community an opportunity to have at least limited access to this vast pool of knowledge. This would actually be a conservation of assets, since those with limited resources would not continue to seek a nonexistent light at the end of the tunnel. A good example of this is a small company called Energy Conversion Devices which had worked with amorphous devices for more than five years and was never able to produce them in quantity. About two years ago, their research finally arrived at a point which began to show some promise and IBM requested, and was granted, a license. IBM began essentially where ECD's research ended, and within 18 months had sufficiently changed the processing techniques and other variable so that it was obtaining product. ECD had committed about $25 million of public stockholders' money to this development, all of which was lost to those shareholders. IBM may have committed as much, although that is doubtful, but it was barely noticeable.

PART III.—THE INSTITUTIONAL INVESTOR'S DILEMMA—INABILITY TO INVEST IN SMALL COMPANIES

The institutional investor has come under attack recently for creating the so-called "two-tier" market, meaning the acquisition of stocks of those companies which have unblemished earnings records. These stocks are also referred to as "one decision" stocks, meaning that a portfolio manager buys them, puts them away, and adds to them in market downturns, but never sells them. One of the reasons for this philosophy is that these companies typically have very large capitalizations and can be purchased in size or in large blocks. Theoretically, they can also be sold in size, but this isn't necessarily so.

Why the commitment to large capitalization stocks? A portfolio manager generally is responsible for a sizeable pool of money—at least $100 million at an institution of any size—which he will invest in 20–30 stocks. His minimum position would therefore be $3–$5 million, and since it is considered unwise to own a sizeable percentage of the market value of a given stock, the portfolio manager typically will look only at stocks with total market value in excess of $100 million. Small pools of capital will invest in lower market capitalizations, perhaps down to the $50 million area, but anything below that is generally considered quite risky. Some of the biggest institutions have aggressive pools of money which invest only in very high risk securities in the hopes of owning an emerging IBM or Xerox in its earliest stages. The University of Rochester has done this very successfully in the past, but because of the lack of venture capital available today, there aren't many startups in the high technology area.

As an illustration, Table II shows the market capitalizations of a random sample of both large and small companies in the overall high technology area. Prices for the calculations are as of July 10, 1974, and the earnings per share are for 1973 or the latest twelve months if the company is on a fiscal year. There are 20 companies in the sample, the six mainframe computer companies, seven semiconductor companies, and seven peripheral equipment companies. The mainframe companies all have market values well in excess of the $100 million criteria and, in fact, all except Control Data have market capitalizations in excess of $1 billion. Again, IBM is the standout with a market value in excess of $29 billion. The semiconductor companies show up fairly well with two of them, Texas Instruments and Motorola, having market values in excess of $1 billion, while three more are in excess of $100 million. Of the two remaining companies, Mostek is close to $50 million, but Advanced Micro Devices is under $20 million. The peripheral equipment companies, however, regardless of earnings, all have market capitalizations well below the $50 million minimum, and only Telex and California Computer are above $20 million.

Obviously, one of the best measures of the value of an investment is the price one pays today for future earnings. While it is true that the stock market is depressed and thus there are many outstanding values in every industry, the technology companies are selling at multiples which signify maturity rather than continued growth. Prevailing multiples for the mainframe companies, including IBM, and the semiconductor companies are at least 10 points below previous bear market lows, but the peripheral equipment companies are selling at multiples which would tend to indicate their imminent demise. The two companies in the industry with the best records, CalComp and Storage Technology, are selling at 5 and 7 times earnings, respectively, based on last year's earnings. In both cases,

earnings are expected to increase this year, so the multiple on future earnings is even lower. Both companies are in need of longer term financing to replace their costly short term bank debt, but are unable to go to the equity market because of the low relative prices of their common stocks. Their debt to equity ratios are already top heavy so that the debt route is closed to them also. The third avenue of cash inflow is also unavailable and this is private placement of some combination of securities with an institutional investor.

The offering statement for a private placement generally contains more information about future product plans and strategies than the prospectus covering a public offering. In many cases a five year plan is included estimating contribution to sales and earnings of both existing and planned products. The peripheral equipment companies are unable to present such a long range plan very convincingly because of IBM's past practices of introducing phantom machines and/or price reductions in the form of long term leases. Furthermore, the peripheral companies have difficulty in establishing the size of their market because of the lack of information on computer shipments per se. The institutional investor has a strong fiduciary responsibility because he is investing funds for others. He must operate under the Prudent Man theory for he is legally liable for the loss of those funds. Based on past experience, prudence dictates that it is unwise to invest in a company which exists only so long as it does not encroach upon IBM's market share. This is especially true with regard to restricted securities, which are not freely tradeable.

The institutional investor is unable to invest in the publicly owned common stocks of the peripheral equipment companies because their market values are far too low. Storage Technology has a market capitalization of less than $30 million and CalComp's market value is just over $21 million. This compares with $29 billion for IBM, $3.4 billion for Burroughs and almost $2.0 billion for Texas Instruments. The dilemma which we face is that on a multiple basis, CalComp at 5 times and Storage Technology at 7 times, are more attractive than either IBM at 18 times and Burroughs at 29 times earnings. CalComp and Storage Technology are also growing faster than IBM or Burroughs, so if the computer market was truly competitive, these two stocks would be selling at a premium. However, investors assume that the computer market is not competitive, and thus the future of CalComp and Storage Technology is uncertain. If the competitive question is not resolved quickly, the viability of these companies is not assured because of their inability to finance internally generated long term growth.

It is to management's credit that these companies have performed so well in the face of unfair and uncommon competition. As an institutional investor, I would like to own CalComp and Storage Technology because I have been given every reason to have faith in management. Fiduciary responsibility and prudence prevent me from doing so because the risks from outside, uncontrolled forces are too great. My universe of acceptable investments has thus been curtailed; conversely, the risk of foreign investment in these companies, and consequent export of their technology, has increased markedly. The management instinct is to survive, and if the only avenue for survival is control from outside the United States, then that is the avenue which will ultimately be followed. We cannot permit that to happen and there is not a great deal of time left to prevent it. The other traditional avenues of finance must be reopened domestically and the doors to foreign investment in our technology companies must be closed. That is the only way in which we will maintain the technological lead which we now have and which is an important aspect in a favorable balance of trade.

PART IV.—THE HEART OF IBM—COMPONENTS

In 1912, in a small house in Palo Alto, California, Lee de Forest and his associates started the electronic revolution by perfecting the vacuum tube as a sound amplifier and generator of electromagnetic waves. That led to the invention of the loudspeaker in 1913 and the beginnings of what is now the Magnavox Company. Vacuum tube companies proliferated, and one of them evolved into Litton Industries. In 1927 two milestones were achieved, the first successful all-electronic transmission of televised pictures and advanced shortwave radio transmitters. In the late thirties, the Varian brothers were unable to find financing for their as yet unperfected klystron tube, a variant of the original vacuum tube, and went to work at Sperry Gyroscope. The klystron tube became the heart of U.S. antiaircraft and antisubmarine radar during World War II. In another development at Sperry, the computer was invented which was to have a limited market

of perhaps five machines. Its heart was the vacuum tube which was developed more than thirty years earlier. Ten years later, or forty years after its invention, IBM used vacuum tubes to build its first computer, the 701; it was introduced in 1953 and all the vacuum tubes were purchased by IBM from outside suppliers. Thus, the original electronics technology, invented in 1912, was widely used for at least half a century, and is still used for some applications.

The next major technological event occurred on December 23, 1947 at Bell Telephone Laboratories. The three distinguished scientists who later won the Nobel Prize for their invention demonstrated the first successful transistor. It was made of germanium and was a point-contact device which looked something like a crystal detector with cat's whiskers. The inventors were Dr. John Bardeen, Dr. Walter Brattain and Dr. William Shockley, and it is the latter who is the father of the commercial semiconductor industry. Dr. Shockley was determined to capitalize on his invention and went to Raytheon in Boston in 1954 as a consultant to establish the first semiconductor company under its auspices. His asking price was $1 million over a three year period, not an unrealistic figure when one considers that today a semiconductor startup costs on the order of $5 million. Raytheon was appalled at that figure and Dr. Shockley followed the advice of Horatio Alger and went West, thereby creating the series of events which established Santa Clara County in California as the semiconductor center of the world. The original Shockley Transistor Corporation, backed by Beckman Instruments in 1955, is the direct antecedent of nearly 25 companies in the San Francisco Bay Area. But Dr. Shockley decided to concentrate on Shockley diodes, a four-layer device, rather than transistors, and eight of his young scientists found a willing backer in Fairchild Camera and Instrument Corporation of Syosset, New York. Shockley Transistor never became the successful commercial venture which its founder envisioned and was sold by Beckman to Clevite, who sold it to IT&T, who was unable to sell it and finally shut it down in 1968.

The eight young scientists who left Shockley were Dr. Robert Noyce, Dr. Gordon Moore, Dr. Jean Hoerni, Dr. Jay Last, Dr. Victor Grinich, Dr. Sheldon Roberts, Julius Blank, and Eugene Kleiner. However, none of these men had any managerial experience, so Fairchild recruited Dr. Ewart M. Baldwin from Hughes to run the new company and gave him a founder's share. About a year and a half later, Dr. Baldwin gained backing from Rheem Manufacturing and started Rheem Semiconductor, which was subsequently sued by Fairchild for theft of trade secrets. Although the suit was settled out of court for an estimated $70,000, Rheem agreed not to use one of Fairchild's proprietary process steps, and after only two and a half years in business, Rheem sold out to Raytheon. So it came about that in 1961 Raytheon acquired the first Fairchild spinout, which was the first Shockley spinout which Raytheon had been offered seven years earlier.

Meanwhile, at Fairchild Dr. Noyce had been asked to become temporary general manager of the semiconductor operation when Dr. Baldwin left to form Rheem. Dr. Noyce held the top position for nine years until he left Fairchild to establish Intel in 1968. As far back as 1961 all was not well at Fairchild Semiconductor, as the Western money-maker continued to provide the financing for its Eastern parent's acquisition program and the founders' stock did not reflect their spectacular performance. Half the founding group, Dr.Hoerni, Dr. Last, Dr. Roberts, and Mr. Kleiner, left in 1961 to form Amelco Semiconductor, which was to be the forerunner of Teledyne Semiconductor. Dr. Hoerni left Amelco in 1964, before its acquisition by Teledyne, to establish a semiconductor department with Union Carbide Electronics. Three years later, in 1967, Dr. Hoerni left UCE to found Intersil, and the co-founder of UCE moved the division south to San Diego where it was said to Solitron Devices in 1969. Also in 1961, another group left Fairchild to form Signetics and they were later joined by F Joseph Van Poppelen, Jr. from Motorola. Signetics' original backing was from Lehman Bros., the New York banking house, but losses during the startup period were extra heavy because the industry was going through its first shake-out and Lehman sold control to Corning Glass The shake-out was occasioned by the switch over from germanium transistors to silicon transistors, and the entire industry was forced to write down huge amounts of inventories as prices declined.

Corning Glass sent in James F. Riley to head Signetics, which caused the departure of Mr. Van Poppelen who went to Fairchild from which Signetics had spun out. In 1969, two of the original founders of Signetics, which was then controlled by Corning Glass, wanted a company of their own which they no longer had, and started Signetic Memory Systems as a subsidiary of Signetics. A third founder backed out at the last minute, Zeev Drori, and found backing from

an MOS memory house, Electronic Arrays, to form a bipolar house, Monolithic Memories.

The transistor was still the dominant device type being built in the early 60's, although technology was progressing to the point where processes for other types of semiconductors were nearly perfected. This is the primary reason for the number of spinoffs which occurred during this period. The biggest loser ever to spin out from Fairchild in 1961 was General Micro-Electronics, which was formed to exploit the new MOS (metal-oxide-silicon) technology. Its co-founders included Howard Bobb and a retired Marine colonel named Arthur Lowell, who was rather a promoter and who coined the acronym, GM–E, which created the impression that the new company was backed by General Motors. Fairchild sued GM–E and that suit was settled out of court but little GM–E was forced to find another sponsor. About a year earlier, Dr. William Hugle and his wife, Dr. Florence Hugle, went to Baldwin Piano in Cincinnati where they established a semiconductor division. They then migrated to California where they set up a consulting firm which evolved into Siliconix. Policy differences ensued, and so it was that in 1963 both the Hugles and Col. Lowell were in Chicago looking for backing for new firms. Hugle was talking to Plye-National and Lowell was zeroing in on Stewart-Warner to back GM–E. Both men were insisting that the new companies be established in California to take advantage of the skilled labor force but both companies were insisting that the new ventures be located in Chicago, the home of the potential parents. Thus negotiations were temporarily suspended, and when they were reopened, there had been a complete change of partners. Therefore, Pyle-National wound up backing Col. Lowell in GM–E and Stewart-Warner set up Stewart-Warner Micro-Circuits under the two Drs. Hugle.

Pyle-National was nearly bankrupted by the losses of GM–E because MOS technology was in its earliest stages, and the process refused to be stabilized. Philco-Ford came to the rescue in 1966 and acquired GM–E, so that it had a major auto company as a backer after all, but even Philco-Ford couldn't tolerate losses estimated at over $1.0 million per month with no revenue. Philco was already in the semiconductor business but in 1968 it shut GM–E down and gave up on MOS technology forever. Meanwhile, the original founder of GM–E, Howard Bobb, left Philco in 1966 shortly after it took over GM–E from Pyle-National and founded American Micro-Systems, which was to be the first successful MOS company. However, it took until 1968, seven years after GM–E was founded, to produce the new type circuits and to turn a profit. Electronic Arrays was formed in 1967 to produce MOS circuits with substantial backing from Phillips, the Dutch company, but profits remained elusive and even in 1973 the company was only moderately profitable.

Back in 1959, Dr. Bernard Rothlein left Sperry (Rand) Semiconductor with a small group and formed National Seminconductor. Sperry sued with a vengence and in the court room succeeded in dramatically winning its case. Its trial attorney used the Sperry Semiconductor organization chart as his primary exhibit and proceeded to place large black squares over the face of each defactor. Sperry won a sizeable judgment against National, nearly forcing the company out of business. It managed to keep going, however, and in 1967 Peter Sprague, a wealthy young investor whose father founded Sprague Electric, bought control of National and persuaded Charles Sporck, then general manager of Fairchild, to join National as president. Sporck took with him four key men, Fred Bialek, Pierre Lamond, Roger Smullen, and Don Valentine, and National got off to a roaring start. Bob Widlar, the wizard designer of Fairchild's most successful circuit, the linear operational amplifier, the 701, was already at National. Widlar redesigned the 701 and National's 101 circuit became the industry standard.

The most successful spin out from Fairchild is Intel, an acronym for Integrated Electronics. Dr. Bob Noyce and Dr. Gordon Moore, two of the original eight Fairchild founders, left, along with Dr. Andrew Grove, to pursue the MOS semiconductor memory market which they believed could shortly become price competitive with ferrite cores. Intel was founded in 1968 with backing from Arthur Rock, the original backer of Max Palevsky of Scientific Data Systems. Five years later, in 1973, Intel had sales of $67 million and had successfully perfected the processing techniques necessary to make high density MOS chips at low cost.

Obviously Fairchild had to replace Dr. Noyce, and so it recruited Dr. Lester Hogan from Motorola, who at the time was preparing to take a group with him and join General Instrument, an early entrant in the MOS business which even today is relatively unsuccessful. Sherman Fairchild was determined to

hire Dr. Hogan and his offer reportedly included an interest free loan to purchase $1.0 million of Fairchild stock under options. Dr. Hogan brought with him eight others from Motorola, who were later to become known as "Hogan's Heroes." This move only increased the number of spin outs from Fairchild as veterans were replaced with their Motorola counterparts. Within a year there were four additional spin outs, the most successful of which was Advanced Micro-Devices, a firm devoted to second sourcing bipolar devices.

The semiconductor industry debacle of 1970 dried up the stream of venture capital which had supported the startups, and there have not been any new companies formed in the past three years. National recently lost one of its founders to another segment of the industry, and it is possible that a spin out might come from Intel in the future, but it appears as though after nearly two decades the formative and confusing years are at last over. No mention has been made of the two largest companies in the industry and for good reason. Texas Instruments has spawned only a few new companies, the largest of which is Mostek with backing from Sprague Electric; IBM Components Division has spawned only two companies, Cogar on the East Coast, which went bankrupt about two years later, and Advanced Memory Systems, which is currently having rather severe problems. A third spin out, Semiconductor Electronic Memories, was financed by Electronic Memories and Magnetics about four years ago, but has yet to develop significant revenues. The schematic Figure 5 shows the genealogy of the semiconductor industry since its inception in 1947.

IBM set up its first West Coast facility in 1943 which was a punch-card plant, but it was not until 1952 that the company established a research center in San Jose, California. It was at that plant that the magnetic data storage disk was invented in the 1950's and that development resulted in a proliferation of spin outs to pursue the new storage medium. It is also true that IBM veterans have formed companies engaged in many other aspects of computer technology, predominantly in the peripheral equipment area. However, only three groups have left the IBM Components Division to strike out on their own and none of them have been successful. The reason, as the following discussion will show, is that IBM's semiconductor expertise lagged the industry until quite recently.

Texas Instruments was one of the twelve original licensees of Bell Telephone Laboratories in 1952 and was in high volume production of germanium transistors in the mid-1950's. In 1954, TI announced the first silicon transistor which was available for certain military programs in 1956. Fairchild announced the double diffusion planar process for silicon transistors in the late 50's and was in volume production in 1961. Back at TI, Jack Kilby invented the integrated circuit in 1958 and the first IC's were commercially available in 1964. IBM's first computer, the 701, used vacuum tubes and that machine was produced until 1959. The 1401 was introduced in 1959 and used germanium transistors, although silicon transistors had been available since 1956. It is difficult to pinpoint the exact time when IBM decided to go into the components business, but in 1954 research and development expenditures leaped to 7 to 8 percent of sales from 3 percent the previous year. Since the first computer (the 701 had been introduced in 1953 and IBM was already planning its next machine, the 1401) we can only assume that management set up and R&D facility in 1954 to pursue the still relatively new transistor technology which was already in volume production at TI. All the vacuum tubes for the 701 computer were purchased from outside suppliers, and the introduction of the transistorized 1401 in 1959 caused a slump in the vacuum tube industry as 701 production was phased out.

The early silicon transistors were quite costly and the very high reliability devices were used exclusively in military programs. Those devices which did not quite meet military specifications were sampled by various commercial enterprises so that their performance characteristics could be designed into equipment which was then on the drawing boards. IBM, however, elected to remain with geranium transistors, which it was then producing in-house, and these devices were used in all the 1401's which were phased out of production in 1964. IBM's largest outside suppliers were TI and Fairchild, but they were used as second sources to fill gaps in IBM's internal supply lines.

By 1960–61, IBM was in the early design stages of its 360 computer, which was to be a family of machines with common architecture, software, and peripherals. The heart of this machine was the components. In spite of the fact that the integrated circuit had been invented at least four years earlier and could easily have been in volume production at IBM and TI and probably Fairchild in 1963, IBM made the decision to use a hybrid circuit which it called Solid Logic

Technology. The decision to use SLT was made in 1961, but the first 360 was not introduced until 1964. SLT was an early form of transistor-transistor-logic (TTL) and was ultimately extremely easy to produce. Each package was built up from a one inch square of ceramic substrate to which the various components were added—the resistors, diodes, capacitors, and transistors. The technique lent itself to extensive automation, and therefore had a very low labor content. Moreover, it was very cheap because the package could be reworked if it didn't pass quality control tests, which gave the packages fantastic overall yields. However, these packages were not available outside IBM and production was absolutely critical to the success of the 360 computer—it was a "you bet your company" product. IBM's organization charts show just how critical these components were; the Components Division operated semi-autonomously until mid-1963 when the entire division was suddenly pulled under the jurisdiction of Vincent Learson, where it remained until the end of 1966 when shipments of the 360's were back on schedule, presumably because SLT yields were finally satisfactory. IBM stayed with the SLT technology until the introduction of the 370's in 1970, although the independent semiconductor companies had by then introduced many other faster and denser devices. Was IBM cautious, or was it deliberately bringing the heart of its machines in-house? We think the evidence shows that the latter answer is correct. If IBM was being cautious, it could have selected several of the semiconductor houses which were proliferating in the early 60's as suppliers, thereby guaranteeing itself at least one second source. But it was only in 1966–67, when the Components Division was dismissed from Learson's jurisdiction, that the decision was made to phase out of the manufacture of all discretes and purchase these devices from outside suppliers. IBM also purchases some other devices on a bid basis, but none of the suppliers really know where the circuits are being used. As one supplier phrased it, "IBM comes in with some specs and wants a bid. We don't know where the circuit is going and we don't know all the parameters, but we all bid. It's a real horse race." We estimate that IBM purchases about $50 million of devices outside and produces about $600 million.

When IBM introduced the first 370 machine in 1970, the circuitry used was another in-house design called Monolithic Systems Technology (MST). However, in 1965 Texas Instruments introduced the most successful logic family in the industry, transistor-transistor-logic (TTL), in the form of the 5400 for military applications and shortly thereafter, the 7400 for commercial applications. Initially, TTL was produced in small scale integration (SSI) only, but by 1969 TI and a few others were building medium scale integration (MSI), and by the time the 370 was introduced large scale integration (LSI) was readily available. Also, Motorola had introduced an even faster device known as the MECL–10,000 Emitter-Coupler-Logic for very high speed computer applications. These devices are used very successfully by all the other computer companies and are produced by at least one dozen suppliers. Yet IBM again decided to do its own thing and produce internally, not necessarily with a high degree of success.

The history of the devices used by IBM in the 370's is revealing; in June 1970, the 155 and 165 were announced with core memory. In March 1971, the 135 and 145 were announced with bipolar memory, but in July 1971 the 195 was introduced with core memory. In August 1972, IBM announced new versions of the 155 and 165 (which had used core memory), the upgraded 158 and 168 which used MOS memory. The last two of the 370 machines to be introduced, the 125 in October 1972 and the 115 in June 1973, both use MOS memory. Again one might ask if IBM were merely being cautious and the answer has to be negative. In 1970 when the first 370 was announced using core memory, several suppliers were already building MOS memories in small sizes, 256-bit devices, and Intel's 1024-bit device, the industry standard #1103 was available. Bipolar devices were also available on a limited basis and volume production was in place in 1972. Moreover, in the 1970-71 period the semiconductor industry was in the throes of a real depression directly related to IBM's introduction of the 370 system as users cancelled orders from other computer manufacturers, and as IBM's outside purchases of discrete devices for the 360 series stopped. The MOS memory houses meanwhile were attempting to convince the other computer and peripheral houses that this technology was the future trend. Data General was considering purchasing MOS memories from Intel in 1971, but IBM had just introduced the 135 and 145 with bipolar memory, and little Data General with $50 million in sales could not risk an untried technology so it stayed with core. Partly as a result of the dislocations created by termination of 360 production and lower purchases of semiconductors by the military, the industry did not add capacity in 1970 and 1971 and was unprepared for the 1972-73 explosion in demand.

But in August 1972, IBM announced the upgraded versions of the 155 and 165, the 158 and 168, using MOS memories. IBM had finally blessed the technology and there was a wild scramble for MOS parts which the semiconductor industry was unable to produce in sufficient quantities; it is only very recently that supply has finally caught up with demand. Meanwhile, the early purchasers of the 155 and 165 with core memories, and there are an estimated 2,000 installations of these machines with monthly rentals of $50,000–$100,000, were offered the opportunity to upgrade their new but obsolete machines at a cost of about $300,000. And so it was that IBM, the industry leader, simply used the oldest technology available, core memory, until it was able to produce its internal needs which took it two years. The history of semiconductor industry introductions and IBM's usage of electronic circuitry is shown in Table III.

Now that IBM has MOS technology perfected, it is apparently gaining a technological lead over the semiconductor industry for the first time. The 135 and 145 machines each use bipolar memory and IBM is putting four 1024-bit (4–1K) chips on a ceramic substrate to form a 4096-bit (4K) module. We know from papers delivered to professional meetings that IBM has the capability of building a single 4–K MOS device and that it has had some limited success with a 32–K MOS device on a single chip. MOS is inherently cheaper than either bipolar or core memories although it is slower, but because the densities can be significantly higher, most memory circuits over the next 3–4 years will probably be MOS. What IBM is apparently planning to do with the 4–K bipolar module in the 135 and 145 machines is to replace that module with a single 4–K MOS chip. It can do this by using a buffer memory which can look back into any kind of memory and ahead at any kind of logic. Therefore, as IBM gets down the learning curve, which it can do more quickly than anyone else because of the huge volumes of only a few kinds of devices, it can simply replace existing modules with single chips; for instance, it is theoretically possible to replace four 4–K MOS chips with a single 16–K chip, or two 16–K chips with one 32–K chip. The other computer companies will not have this capability for a significant period of time because their suppliers, the semiconductor companies, must make a profit on the components which they produce and they cannot produce these chips profitably for some time.

In the semiconductor process, the most critical factor in profitability is yields, the number of good chips from a wafer, and the most critical factor in good yields is good chip design. At the present time the semiconductor industry is struggling to produce 4–K MOS parts in quantity, but is unable to do so because of very low yields, which in turn make the parts too expensive to be cost competitive. Each three inch silicon wafer, which is the building block for the chips, can contain 200 potentially good chips, each 21,000 square mils (the smaller the chip size, the more chips on a wafer; the better the yields, the higher the profits). In the early to middle stages of production, the yields are terrible; initially there might be one good chip out of every other wafer, then you would get one good chip from every wafer, then perhaps two good chips per wafer, and so on. In the middle stages of production, a 10 percent yield would be considered absolutely fantastic; that would yield twenty devices at the wafer fabrication level. However, the semiconductor process is terribly complex and these die must then go through additional manufacturing steps which include scribe and break, first optical, die attach, bond mold or seal, and final test. At each level in the process more die are lost, so that the final yield is usually 50 percent less than at the wafer fabrication level, or in this case ten parts per wafer. At present, the semiconductor industry is still in the early stages of producing the 4–K chips so that yields are still at very low levels, perhaps five good chips per wafer. By 1976, we think yields could triple to about fifteen parts per wafer, which at an average selling price of $14.00 in OEM quantities, would produce a profit of $100 per wafer, the absolute minimum required to cover the other costs of doing business.

IBM does not have the same cost requirements as do the semiconductor companies because its profits are derived at the system level and components do not necessarily have to be profitable items when they are first used. On the other hand, the semiconductor companies cannot afford to sell chips to the computer mainframe companies at a loss even though these chips might make their products more cost effective. The IBM Grey Book on the 135, which was one of the exhibits in the Telex trial, details IBM's strategy in the components area and emphasizes the importance of the new technologies as they relate to IBM's costs over the life of the product. Exhibit No. 115, page 43 "* * * The Memory technology, Phase 21, absorbs about 50 percent of each new build cost, while the

MST–2 logic cost accounts for another 25 percent. Both technologies are cost sensitive to quantity variations and yield percentages. The performances of East Fishkill, Burlington, and Endicott CPM are, therefore, as vital to the financial success of the M135 as the effectiveness of Kingston in providing the power and the assembly and test functions * * *." In other sections of this same document IBM details its strategy in pricing the CPU and the memory, again dependent upon yields and upgrading Phase 21 to the newer technique. If, as IBM seems to suggest, 75 percent of new build cost is accounted for by components, then the other computer mainframers are indeed at a great disadvantage, but the reasons are far more complex than just the cost of components.

IBM is quite probably the most profitable semiconductor manufacturer on an unallocated cost basis because it does not produce a broad line of circuits, only those which it uses in its own products. Volume is the key to profits in the components business, and IBM clearly has the longest production runs of any of the houses. What other house can run the same product with no iterations seven days a week for two or three years? IBM's research and development activities in the components area are also extremely effective because it can allocate all of its expenditures to the improvement of technology for computing purposes. It does not need to open new markets in the consumer area, such as hand held calculators or electronic watches to assure future growth, nor does it have to market to several different classes of customer. In 1973 IBM spent $730 million on research and development; if we assume that at least 10 percent of that was spent in the components area, then $73 million was spent on improving components for computer usage. The semiconductor industry spent an estimated $150 million on research and development in its four major markets, government, consumer, industrial, and computers. If those dollars were allocated equally, this would mean that 25 percent of the $150 million was spent on computing uses, or about $38 million, approximately half the amount spent by IBM. In reality, we suspect that IBM spent more than $73 million on components since we have shown how critical they are to the computer business, and would not be surprised if that figure was closer to $100 million, or three times the amount spent by the other semiconductor manufacturers for improving computer products.

These figures become even more distorted when one considers that the $38 million spent by the semiconductor industry was spread among five computer mainframe companies, about a dozen minicomputer manufacturers, and at least 100 other computer-related customers. Each of these customers has to develop a close working relationship with its components supplier because the needs of each are different from the other. Therefore, creative manpower is also spread among the various customers, but more importantly, the supplier must know the precise needs of the customer in order to offer the optimum circuitry. This was not true when computers used transistors but in today's technology an outside supplier effectively has control over system performance instead of the designer of the system maintaining that control—except IBM. When IBM begins the design process on a new computer family, all of its needs are available in-house, especially the components division. Questions are posed and immediately answered—yes we will have a 4–K chip ready in 1974 if we are given X dollars. The profitability tradeoffs can then be figured, and if it makes economic sense to use four 1–K devices until Components is able to make a 4–K device, it really doesn't matter because the turnaround time among all divisions can be integrated so that no slowdown in production occurs. Perhaps more important than anything else is the absolute secrecy which is maintained internally because no outsiders need to be involved.

As the above discussion shows, IBM is moving from a follower to a leader in semiconductor technology and the pace appears to be accelerating, so that IBM will clearly be at the forefront in semiconductors for computing usage in a few years. When Control Data sued IBM, part of the relief it requested was that IBM's Components Division be spun out so that the other computer mainframers had the benefits of what was then only beginning to be technical superiority in the semiconductor area. IBM admitted de facto that its Components Division was critical by dismantling it as a separate unit in 1971 and spreading it over all other divisions so that it was not easily separable. IBM's semiconductor expertise must be made available to the other computer companies in order to assure future competition. Furthermore, the Semiconductor Test Equipment Division must be spun out as well since it is a necessary adjunct to the use of made-in-IBM components.

PART V.—THE SEMICONDUTOR INDUSTRY WITH IBM AS A COMPETITOR

As we have pointed out, IBM has recently gained a technological lead in semiconductors as a result of devoting $70–$100 million to research and development for computing use, compared with an estimated $38 million by the semiconductor manufacturers. Table III on page 37 shows the lead which IBM is believed to have in producing 4–K MOS memories and the expected lead it will have over the next several years, which in effect is a quantum jump. However, another factor of great importance is that this quantum jump could very possibly involve a completely new type of technology which IBM will have perfected that will not be available industry-wide until the 1980's. At present, IBM is known to be conducting research on charge coupled devices (CCD's) and the other semiconductor houses are working on this type of circuitry also. In fact, a few CCD circuits have been announced by Fairchild, although they are not yet available in any quantity, if at all. The CCD technology is akin to MOS processing techniques and I have no doubt that the semiconductor houses will be able to produce them in time. However, there is some question as to when the semiconductor houses will be able to produce 8–K or 16–K MOS memories because the present photolithography method is marginal at that degree of density. It is probable that electron beam lithography will be required to produce the high degree of resolution necessary to properly diffuse the wafers, and this equipment is not available as yet. This creates a real problem for the other computer mainframers in the 1976–77 time frame because IBM is certain to use its technological advantages in designing the FS, expected to be introduced about that time.

Further on down the road, IBM may elect to use bubble memories which are totally unlike semiconductors. Bubble memories are not produced from silicon, which is the basic material used in all other semiconductors, including MOS. CCD's do use silicon but they represent an advancement of about six years in the logic function and about four years in the memory function from present solid state devices. CCD's would typically be used as long serial shift registers in buffer memories; bubbles would be used to replace core or other semiconductor devices in the main memory since they are extremely high density devices. If IBM uses CCD's in the buffer, cache or scratch pad memories, and bubble memory in the CPU, the other computer mainframers would not be able to introduce competitive systems for about five years after IBM announced FS. Furthermore, the semiconductor houses' computer market share would erode because it is not certain that today's devices would be compatible with bubble memory techniques. The only other company known to be advanced in the bubble memory techniques is Bell Telephone Laboratories. In summary, the other computer mainframers would not have a source of supply since both IBM and BTL produce for in-house use only, and the semiconductor companies might not be able to produce.

In order to show that the semiconductor industry would remain a very viable and strong competitor if IBM Components were spun off, I have constructed three tables showing industry statistics, company statistics, and projected growth rates for selected devices through 1978. Table IV shows U.S. factory sales of all types of semiconductors for the decade 1969–1978. The evidence is conclusive that the semiconductor industry is a growth industry, and that that growth is expected to continue through 1978 (most forecasters do not go beyond 1978 because of expectation of IBM's FS announcement). The largest market segment is computer and business equipment with a 39.3 percent share in 1969 and a 37 percent share in 1978, excluding IBM in both cases. The second largest share is total automotive and consumer which was 17.4 percent in 1969 and is expected to rise to 18.6 percent in 1978. Fairchild forecasts the data on a worldwide consumption basis as shown in Figure 6.

If IBM were introduced into the marketplace as a supplier, initially it would acquire some share of the computer and business equipment market, which would be the memory segment of that market. Intel, the leading semiconductor memory house, has recently published forecasts for the memory market through 1976 which are shown in Table V below. Intel's estimates for memory apply entirely to the computer memory market which includes mainframes, small business computers, industrial minicomputers, terminals, communications equipment, and microcomputers.

TABLE V

SEMICONDUCTOR MEMORY MARKET

[Millions of dollars]

Type	1973	1974	1975	1976
RAM	86	257	333	408
ROM PROM	53	104	101	102
Registers	30	39	33	36
Total	169	400	467	546

MEMORY PENETRATION

[In percent]

Sector	1973	1974	1975	1976
Computers	13	39	52	72
Terminals	80	95	100	100
Communications	0		1	2
Other	100	100	100	100
Total	16	38	51	69

Source: Intel.

There are, however, many other new applications for semiconductor memory in noncomputer areas such as telephony, automotive markets, home appliances and security systems, games and disk replacement. If we assume that the computer semiconductor memory market expands to $650 million in 1978, and that IBM can capture an unrealistically high 50 percent of that market, then in 1978, IBM would have a 22.4 percent share of the total market for computers and business equipment (650 million divided by 50 percent=$325 million, divided by $1446 million=22.4 percent. However, that would result in only 8.3 percent of total U.S. factory sales of semiconductors of an estimated $3.9 billion.

The next question to be answered is the size of IBM Components relative to the other semiconductor companies in the industry. Texas Instruments is the industry leader with total sales in 1973 of $1.3 billion, of which about $650 million is estimated to be semiconductors, and of that, about $350 million is integrated circuits. Motorola is the next largest with $400 million in total semiconductors, followed by Fairchild and National Semiconductor. The ten largest producers have total sales of about $1.8 billion, with only $50 million in estimated shipments going to IBM. I estimate that IBM Components has total volume of about $600 million, all in integrated circuits based upon the assumption that the company purchases all its discretes from outside suppliers. IBM would therefore be the largest integrated circuit company, but Texas Instruments would still be the top semiconductor producer in the industry. Table VI gives some pertinent data for each of the ten largest companies.

In attempting to set up an income statement for IBM Components as a separate operating unit, I have used Intel as the most realistic model since it is the lowest cost producer in the industry. Manufacturing costs are obviously low because of its extremely high run rates on a limited number of circuits. I have used depreciation allocations higher than the rest of the industry, including Intel, because IBM's production process is highly automated and because the company uses very conservative accounting. The industry typically depreciates semiconductor manufacturing and test equipment over a 2–4 year period, and I have assumed a two-year period for IBM. As previously discussed, IBM spent $730 million on all research and development in 1973, and probably $70–$100 million of that was allocated to semiconductors. Cost of sales is therefore 70 percent of Components' revenues. Determining marketing and general and administrative expenses was somewhat more difficult, and so I used the ratio experienced by the newest company in the industry, Advanced Micro Devices, at 19 percent. Intel's SG&A expenses have been running at only 11 percent but that ratio is now shifting to a much higher level as the company begins to ex-

pand its market penetration outside of the computer memory market. Putting all these hypothese together, IBM Components would have an operating margin about the same as Texas Instruments, Fairchild, and Motorola, but lower than Intel, Mostek, and Advanced Micro Devices, which probably can be attributable to relative size. The variations which occur by changing the various factors is shown in Table VII.

In conclusion, I believe this simple group of tables shows that IBM would be a viable competitor in the semiconductor industry and that the other companies which now dominate the industry would not be placed at a competitive disadvantage. Furthermore, the other computer companies would be able to compete much more effectively if they could use IBM's semiconductor memory devices which will surpass those of the independent semiconductor companies in the 1975–76 time frame. No attempt has been made to estimate revenues for IBM's test equipment operations, but the total market today is probably $150–$200 million. It is highly cyclical and is currently in a boom year. The inclusion of revenues from this source could increase IBM Components Division revenues by as much as $25 million. TI and Fairchild also build this type of equipment but revenues are not available. The major companies would probably retain their present competitive characteristics.

TABLE VII

IBM COMPONENTS, INC.

[Dollar amounts in millions]

	1972		1973		1973	
Sales	$600	Percent	$600	Percent	$600	Percent
Cost of sales:						
Manfacturing	$3C0	50.0	$330	55.0	$330	55.0
Depreciation	21	3.5	21	3.5	21	3.5
Research and development	73	12.2	9C	15.0	80	13.3
Total	394	65.7	441	73.5	431	71.8
Selling, general and advertisement	120	20.C	120	20.G	90	15.0
Total expenses	514	85.7	561	93.5	521	86.8
Pretax income	86	14.3	39	6.5	79	13.2

[The tables and figures mentioned follow:]

TABLE I. COMPARATIVE 1973 FINANCIAL DATA ON MAJOR COMPUTER MAINFRAME MANUFACTURERS

[Dollars in millions, except as noted]

Company	Total revenue	EDP revenue only [1]	EDP revenue as percent of total	Total pretax income	Total net income	Total R. & D.	Total employees	Cash and equivalents	Long term debt	Share-holder's equity	Net computer rental base
IBM	$10,933	$8,684	79	$2,946	$1,575	$730	274,000	$3,322	$652	$8,812	$3,749
Sperry Rand	2,613	1,128	43	212	113	146	99,000	26	336	980	212
Honeywell	2,391	1,177	49	190	104	160	98,000	81	436	952	816
National Cash Register	1,840	550E	30	142	72	52	81,000	121	539	645	258
Burroughs	1,284	950E	74	208	116	66	47,000	97	261	987	469
Control Data	936	936	100	42	17	48	36,000	18	244	895	255
Total	20,057	13,425	67	3,740	1,997	1,202	635,000	3,665	2,468	13,271	5,759
BM as percent cf total	54.8	64.7		78.8	78.9	60.7	43.1	90.6	26.4	66.4	65.1

[1] Includes sale and rental of equipment, and related services.

Note: Data are for fiscal year ended Mar. 31, 1974 for Sperry Rand and for year ended Dec. 31, 1973 for all other companies.

Figure I

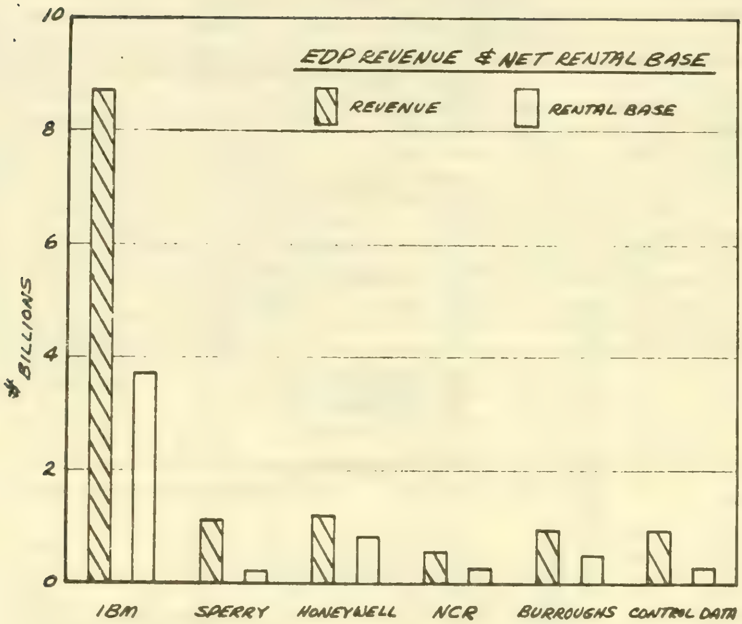
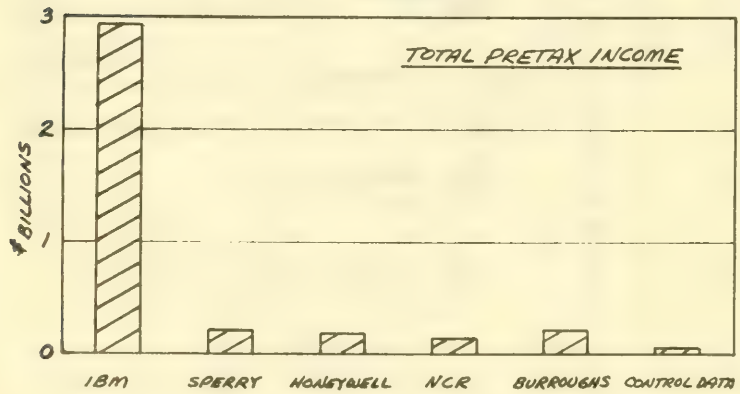


Figure 2



NOTE: ALL DATA FOR YEAR ENDING 12/31/73 EXCEPT SPERRY RAND (3/31/74).

Figure 3

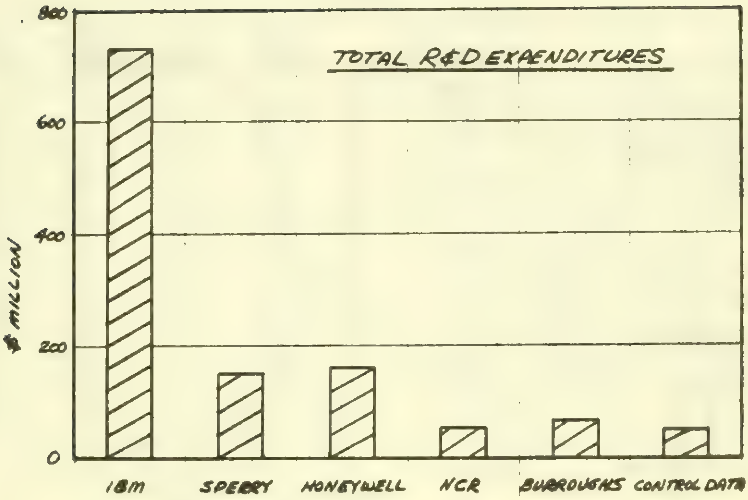
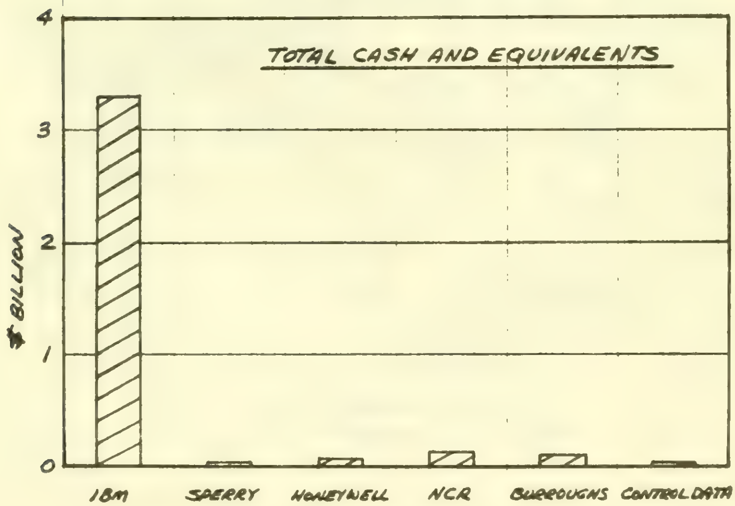


Figure 4



NOTE: ALL DATA FOR YEAR ENDING 12/31/73 EXCEPT SPERRY RAND (3/31/74).

TABLE II

Company	Price	1973 earnings per share	Price/ earnings	Shares outstanding (millions)	Market value (millions)
Advanced Memory Systems [1]	$9	($0.19)	—X	1.3	$11.7
Advanced Micro Devices [1]	7	.98	7.1	2.4	16.8
Burroughs	88	3.00	29.3	39.0	3,432.0
California Computer Products	7	1.57	4.5	3.1	21.7
Control Data	20	3.70	5.4	15.9	318.0
Data Products	3	.22	66.0	6.8	20.4
Fairchild	30	5.12	5.9	5.1	153.0
Honeywell	54	5.12	10.5	19.2	1,036.8
IBM	198	10.79	18.4	146.9	29,086.2
Intel [1]	34	1.41	24.1	6.2	210.8
Memorex [1]	2			4.3	8.6
Mostek [1]	12	1.89	6.3	3.9	46.8
Motorola	48	2.95	16.2	28.0	1,344.0
NCR	28	3.10	9.0	22.8	638.4
National Semiconductor	12	1.40	8.6	11.3	135.6
Potter Instruments	2	(.83)		2.8	5.6
Sperry Rand	33	3.27	10.1	34.4	1,135.2
Storage Technology [1]	9	1.28	7.0	3.3	29.7
Telex	2			10.5	21.0
Texas Instruments	84	3.67	22.9	22.8	1,915.2

[1] Traded over the counter.

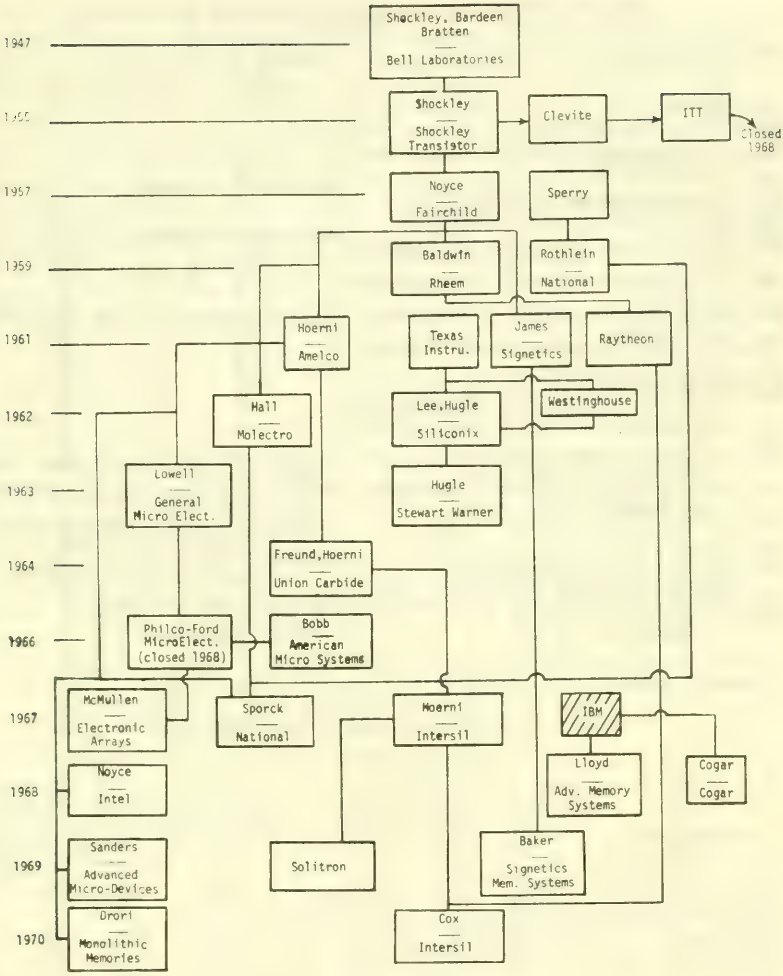


FIGURE 5. SEMICONDUCTOR INDUSTRY GENEALOGY

(Courtesy of Electronic News, January 25, 1971)

TABLE III.—HISTORY OF SEMICONDUCTOR INTRODUCTIONS VS. IBM USAGE

Year	Industry introduction	IBM usage
1912	Vacuum tube	
1946	Sperry builds first computer	
1947	Transistor invented	
1952	Texas Instruments gets license from BTL and makes germanium transistors.	
1953		701 introduction using vaccum tubes.
1954	Texas Instruments makes silicon transistors	
1958	Texas Instruments invents the integrated circuit	
1959		1401 introduction using termanium transistors.
1961	Texas Instruments begins making simple integrated circuits.	
1962	Fairchild makes transistors with double diffusion planar process.	
1964	Fairchild makes integrated circuits with double diffusion planar process.	360's introduced using solid logic technology-hybrids.
1965	Texas Instruments announces transistor-transistor-logic (TTL).	
1967	Small scale integration—Industry-wide	
1969	Medium scale integration—Industry-wide; Motorola announces MECL-10,000 emitter-coupler-logic; American Micro-Systems—MOS circuits, metal-oxide-silicon.	
1970	Intel announces P-Channel MOS process for memories; Texas Instruments—Bipolar memories.	370/155 and 165 using monolithic systems technology with core memory.
1971	Intel announces N-Channel silicon gate MOS process No. 1103 memory circuit 1-K device.	370/135 and 145 using MST with bipolar memory-370/195 using MST and core.
1972	1-K and 2-K devices available—ASP[1]—$14	370/158 and 168 with MST and MOS memory using 1-K devices—370/125 with MST and MOS.
1973	4-K MOS devices announced—1-K—ASP—$11	370/115 with MOS 1-K devices.
1974	4-K MOS devices shipped in limited quantities by TI, Intel and Mostek—ASP of $4, 1-K—ASP—$3.	Switch 1-K bipolar to 4-K MOS in 135 and 145.
1975	4-K MOS generally available but ASP is still $14	4-K MOS now cheap—ASP—$6-$8.
1976	1-K—ASP—$2—4-K—ASP—$8	4-K—ASP—$4-$5.
	8-K available—ASP—$14	16-K or 32-K available.

[1] Average selling price.

TABLE IV.—UNITED STATES FACTORY SALES OF SEMICONDUCTORS

[Dollars in millions]

End use market	1969 Amount	1969 Percent	1973 Amount	1973 Percent	1974 Amount	1974 Percent	1978 Amount	1978 Percent
Consumer	$194	15.6	$250	12.0	$300	12.6	$475	12.2
Automotive	22	1.8	50	2.4	90	3.8	250	6.4
Computer (Business Equipment)	487	39.3	825	39.7	911	38.1	1,446	37.0
Communications	169	13.6	310	14.9	358	15.0	586	15.0
Instrumentation and controls	169	13.6	362	17.4	418	17.5	699	17.9
Government	200	16.1	283	13.6	310	13.0	449	11.5
Total	1,240		2,080		2,387		3,905	
Percent increase			67.7		14.8		63.6	

Source: RCA.

TABLE VI.—ANALYSIS OF INCOME STATEMENTS AS PERCENT OF SALES FOR SELECTED SEMICONDUCTOR CO7PANIES, CALENDAR 1973

[In percent unless otherwise indicated]

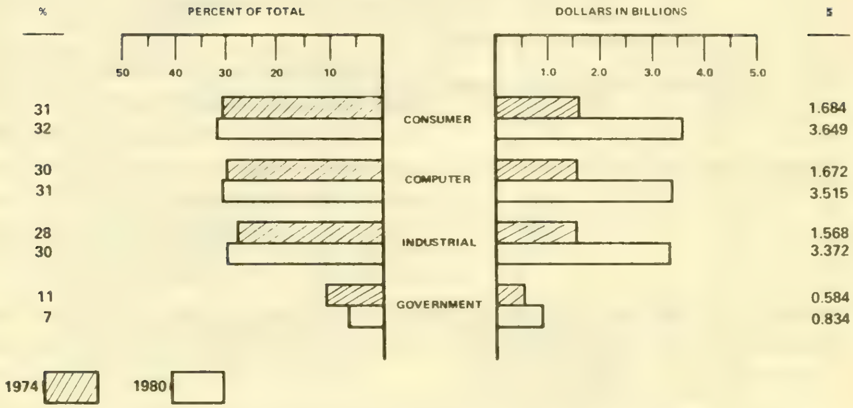
	1973					1973				
	Fairchild	Motorola	National semi [2]	Texas instruments, 1973	Advanced microdevices [1]	American microsystems	Intel	Intersil	Mostek	Signetics
Sales (in thousands)	$351,171	$1,437,100	$155,479	$1,287,276	$21,461	$58,099	$65,593	$24,228	$41,905	$98,274
Sales	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Cost of sales:										
Manufacturing cost	[2] 66.5	59.2		[2] 66.1	57.5	63.4	50.4	63.0	49.3	62.4
Depreciation	3.4	2.5		4.6	2.3	3.1	3.1	2.9	2.2	5.4
Research and development	([2])	6.6		([2])	6.0	5.9	7.0	7.2	5.7	6.5
Total cost of sales	69.9	68.3	75.6	70.7	65.8	72.4	60.5	73.1	57.2	74.3
Marketing and G. & A	17.6	20.6	13.0	15.2	19.1	14.2	11.2	15.3	13.6	12.7
Marketing					12.9			10.0		
G. & A					6.2			5.3		
Total	87.6	88.9	88.6	85.9	84.9	86.6	71.7	88.3	70.8	87.0
Retirement and profit sharing				2.8						
Interest and miscellaneous	1.0	1.2	.3	.5	0	.9	0	0	0	1.4
Total cost and expenses	88.6	90.1	88.9	89.2	84.9	87.5	71.7	88.3	70.8	88.5
Operating margin	11.4	10.0	11.1	10.8	15.1	12.6	28.3	11.7	29.2	11.5
Other income	3.0	0	.2	.5	2.0	0	.9	1.3	.8	.7
Pretax income	14.4	10.0	11.2	11.3	17.2	12.6	29.2	13.0	30.0	12.1
Tax rate	47.0	42.9	45.1	42.8	47.0	31.5	51.9	47.6	47.5	50.1
Net earnings	7.6	5.7	6.2	6.5	9.1	8.6	14.1	6.8	15.7	6.1
EPS	$5.12	$2.95	$.79	$3.67	$.79	$2.26	$2.12	$.60	$1.89	$1.34

[1] Latest 12 mo.
[2] Fairchild and Texas Instruments define R. & D. costs differently than other companies, therefore, manufacturing costs and R. & D. costs are combined in the manufacturing cost number.

Figure 6

FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

WORLDWIDE SEMICONDUCTOR MARKET
End-Equipment Market Consumption Patterns



Senator HART. Our next witness is Royden C. Sanders, Jr., president of Sanders Associates, Inc.

I have a message here from Senator McIntyre. He hopes you will repeat what you personally told him. We are going to hear from you now.

STATEMENT OF ROYDEN C. SANDERS, JR., PRESIDENT, SANDERS ASSOCIATES, INC., NASHUA, N.H.

Mr. SANDERS. Thank you, Mr. Chairman. I am Royden Sanders of Sanders Associates and we have a prepared statement today. We will submit it for the record.

Senator HART. It will be printed in full.

[Mr. Sanders' prepared statement appears as exhibit 1 at the end of his oral testimony.]

Mr. SANDERS. With your permission I will summarize our position.

First of all, we appreciate the opportunity to share our views with you. Sanders Associates is predominantly an electronics company, with total sales of $170 million, about $25 million of which is derived from the commercial data processing market, principally in cathode ray display terminals used to communicate to and from data processing systems. That relatively low figure may class us as one of those cottage industries which Mr. Katzenbach referred to on Tuesday. But because we are at the forefront of the distributed processing and the display terminal market we feel we have carved an important niche in the fastest growing segment of the industry.

Our field is dominated by IBM and we have had, and continue to have, our private antitrust differences with IBM. The nature of those differences has been discussed by some of the previous witnesses. Mr. Biddle touched upon IBM's use of software to disconnect competitive

devices. We have suffered from that and we intend to take care of that privately or by private antitrust action. But today we want to discuss a much larger threat, and our views on how to deal with it.

In addition to terminals, Sanders has technical expertise and business interest in the communications satellite field. Our insight into the domestic satellite situation, coupled with our experience in data displays, places us in a unique position to register the enormity of IBM's latest move: Acquisition of controlling interest in the CML Corp. CML has been approved by the Federal Communications Commission to start domestic satellite service.

Domestic satellites are the key to low-cost communications. A properly implemented switched satellite system providing neutral or transparent interconnections to all users, with no built-in bias toward one equipment supplier, would be very beneficial to the American public and the industries which supply it.

Actually, IBM has sold the business community two or three times the main-frame capacity it needs or can efficiently use at this time.

With the introduction of IBM's nonswitched satellite very little of this excess capacity will become available or useful. On the other hand, a properly implemented switched satellite system will make this excess capacity useful, and could consequently reduce computer users charges two or three times. This could usher in an era of vigorous competition in the field of distributed processing, which you have heard so much about.

However, IBM's entry into the communication picture gives it a means to control all elements of the distributed systems: The central computer, the communication paths, and those remote devices such as display terminals connected by the communications facilities. Having oversold the main-frame market today IBM will seek to control the growth rate of the emerging market to its own advantage.

What's more, the IBM method of control will make it next to impossible for meaningful competition to arise, giving a new twist to a very successful anticompetitive tactic they have employed for years in the data processing market. IBM will keep secret until the last possible moment the means of interconnection of devices using the communications systems, and they will be so complex when they are released that competition will never catch up. IBM will own the systems and, therefore, the markets from computer through communications to a wide variety of applications-oriented terminals.

In fact, technology exists today that would enable IBM to simply bypass much of the local telephone plants now operated in urban areas by A.T. & T. for business communications by the use of a very small rooftop antenna that communicates directly with the satellite. IBM has the voice/data switching equipment already in production which would complement its traditional data processing line to allow it to completely take over all business information handling and communication needs. This is the integrated business system market just opening up.

The user community will be confronted with a dilemma of accepting the full IBM product line offering or running the risk of acquiring superior independent equipment only to find it disconnected by IBM's capricious manipulation of the interface. If an independent does manage to supply a device that hooks on in competition with an IBM busi-

ness product and there is a problem in the IBM communications systems, whose installation do you think will receive primary attention by an IBM-dominated CML?

Many more examples could be given, but, in short, the potential for harm is far too high to allow any relationship between IBM as a supplier of communications services and IBM as a supplier of business or terminal equipment. The difficulties of the A.T. & T.-Western Electric vertical arrangement are far too clear to let a similar situation develop.

Some means is needed by Government to insure that the degree of concentration I have forecasted here—total domination—does not occur in this new field that is being created out of two old ones; computers and communications. Our prepared statement places this market at $250 billion by 1980, and IBM could easily end up with the lion's share of that.

Because of its concentration on the American Telephone & Telegraph Co. and its lack of jurisdiction over data processing, the Federal Communications Commission is not in a position to fully safeguard the public interest. In fact, there is no Government operation equipped to handle the problem created by IBM's entry into communications. Those who are viewing IBM's entry as a panacea for the A.T. & T. problem are making a catastrophic mistake.

Whether or not the industrial reorganization bill is a vehicle to accomplish the type of Government control required, I cannot honestly say. I do think the current method of Government antitrust prosecution is very ineffective. The most glaring example is the curent Government litigation against IBM. From our brief contacts with the litigation team they appear to be understaffed, especially when compared to the legions of lawyers retained by IBM. They have had to accept a cutoff date of 1972 insofar as their case is concerned, and that is unfortunate for many of IBM's most anticompetitive plans conceived previously are only now being implemented. Many aspects of the computer industry are not being covered by Government prosecution. This can only lead to a judgment or, and this we fear the most, a near term consent decree that is designed to punish only some of the past sins and which does not recognize the change in the market IBM is in the process of forcing and then occupying.

But something must be done, giving the immediacy of the problem we have outlined. A dedicated judicial or Government mechanism, with the resources to accommodate continually changing market circumstances and the power to enforce policy in that environment, is required for solution to the IBM problem; today's, which Justice is attacking in a limited fashion, and a broader one of the CML acquisition.

We wish this committee well in efforts to find solutions to those pressing national problems.

Thank you very much.

Senator HART. Thank you very much for a very effective summary.

Mr. O'Leary?

Mr. O'LEARY. Mr. Sanders, let me see if we understand the significance of this acquisition that you have made a reference to.

If I misstate things, or go wrong, please don't hesitate to correct me.

As I understand it, it used to be that computer users generally have their computer on the premises, and that we are now moving into an era where the user may have terminals for intelligence, or a series

of computers in different parts of the country linked together by a communications line.

Do I understand that your fear is that by virtue of this acquisition IBM will be able to offer the whole package; in other words, the data processing? And the computers will bounce an electronic impulse off a satellite and link up these various computers and terminals into one service and one system?

Mr. SANDERS. Well, there is no question about the fact that either the satellite system being proposed by IBM, nonswitched system or the much superior switched system, which we have referred to, will provide superior computer results to the customer.

The difference in the switched system is that when you have a switched system the computer terminal will have the ability to access more than one computer in an effective useful manner. And it will be very much similar to the computer terminal; the computer terminal will then have the utility of the way you can dial any other telephone in the country.

So you will go from a slave to one particular computer into something that can access any of the data bases, any place in the country, with an effective cost mechanism for distributing those costs.

Mr. O'LEARY. Can you give us an example of a user to whom this kind of service would be especially appealing?

Mr. SANDERS. Well, I think we make all the Avis Wizard terminals, for example, that you see in the different airports. Now, there's about a thousand such terminals, and they can only speak because of the way the telephone network would be, or the nonswitched system that IBM would talk about, to a pair of 360/65's in Garden City.

Now, in going to rent a car at the terminal, the girl takes your application for the car and she makes up what is known as a transaction which the telephone system sends to Garden City, it is then processed by the computer and sent back.

The example I'm giving is those 360/65's, which cost about $5 million a year to operate and are about 26 percent utilized.

Now, in a switched system you would be able to, let's say, access and make your hotel reservation; you might be able to pick up your airline ticket; everything would be done at one particular point, with a great deal of convenience for you as the user, because the same terminal, as such, which is a fairly good example of a transaction terminal—designed maybe 4 or 5 years ago, but it's still a pretty good example of a transaction terminal—would be effective in this area.

And, the illustration of just making the one reservation versus, let's say, lining up your entire trip would be a good one.

Mr. O'LEARY. The system that you describe for Avis Rent-a-Car now presently goes through telephone lines to reach the computers in Garden City?

Mr. SANDERS. That's correct. In either system you would locate a terminal on the rooftop of the building in which Avis houses its computer and it would bypass all of the A.T. & T. network that leads up to that.

There would be an antenna on the airport that would connect up with all the terminals that happen to be located in the airport. So, you see, in that way you would bypass the use of all of A.T. & T.'s lines.

Mr. O'LEARY. What differences, if any, would exist with respect to cost and speed?

Mr. SANDERS. I think the minimum saving, for example, between the Avis case—I think the Avis telephone bill is around $1½ million a year—and the saving in the telephone bill would be a factor of two or three times.

Their computer utilization—because if they were connected up to it, they could sell the transaction calculation capability elsewhere—would again be reduced by a factor of two or three times.

It could probably run about 75 percent capacity instead of 26 percent capacity. These total savings, that might result to Avis about $3 or $4 million a year, could be then passed on to the customer in just that one account. And that is just one typical account that would be thus affected.

Now, unless you really make this computer capability available, and useful, by means of a switched system, if you are in IBM's position you would tend to regulate the amount that would become available and only introduce the switched system much later in time, because otherwise you would go through another period like you did in 1970 and 1971, except probably a great deal more severe, when we had an oversupply of main-frame capacity.

I think this probably explains why IBM is taking the risk of getting so close to being regulated by going into the communications market.

Mr. O'LEARY. Your statement describes the problems you had, if I recall correctly, with the IBM 3270, and when you say your terminal was one with intelligence, I assume that means it can perform a computing function, it has a memory and some logic?

Mr. SANDERS. Well, I think when we talk about intelligence, I think most anything but the simplest terminals, including our earliest terminals, had intelligence.

The earliest terminals which we put out about 1966 had as their feature the fact that they had more intelligence than our competitors.

What happened with the 3270—and this is borne out by the IBM management-Telex information—was that IBM determined that we had a much better terminal, and so they copied our terminal. We had a clever way of putting that intelligence in the terminal by using a thing called "attribute characters."

So, when they copied this—our design—and we heard this, we thought this was a very—you know, imitation is the most sincere form of flattery, except when they came out with the 3270, which was basically a modern copy of our earlier 720 terminal, they used attribute characters, but they used different attribute characters. And as a net result, when they introduced them and changed the software, it was just like changing the track gage.

Until they reduced the software support, in fact, our sales went up. But as soon as they employed the anticompetitive action of changing the software, then everybody said this is the game IBM's going to play, and in 1 month our rate of sales went down from a booking rate of $3 million worth of terminals a month down to $1 million worth of terminals a month; and stayed there.

It took a very, very long time and a complete change of line before it built up again.

Mr. O'LEARY. I want to see if I understand it and can make it clear for the record. Your product requires software and your software has to be able to interface or be compatible with their software.

Mr. SANDERS. Yes.

Mr. O'LEARY. When they say they will not support that software, putting this in simple terms or crude terms, does that mean that someone from IBM does not come out and update or rewrite that software which they are using, which has to be compatible with yours?

Mr. SANDERS. Well, the software that the customer was using will work, and continue to work. What the effect of the software withdrawal means is that IBM will no longer make its improvements compatible, and it's an effective disconnect because the customer has built up a situation of dependence on this. So by withdrawal of that, effectively the customer knows well, I've got 4 months, I've got 6 months; depending upon my particular situation, maybe I can stand still 9 months.

But he makes the decision to terminate and he does terminate. And you get millions of dollars of terminals that then slowly start to flow back in because he has disconnected you, very arbitrarily, in the matter of the software.

Now, when we put pressure on IBM a year later they finally reinstated that software support. But it has not been effective in terms of really substantially canceling the flow because the trend and the switch to the other machines was then clearly in progress.

Mr. O'LEARY. Does this problem also exist where you are dealing with terminals that do not have intelligence or do not have the same intelligence as the product line that you described?

Mr. SANDERS. Well, it is not the software switch and the software disconnect has not yet happened on all the terminals. In remote job entry, which is a very popular type of situation, the switch has not occurred.

We are positive that the switch is coming and that these arbitrary, capricious types of switchouts are occurring. And we believe it is one of the fundamental domination policies of IBM.

We have negotiated as hard with IBM as we know how, and they have told us that if we want a change, that we must go to court.

Mr. O'LEARY. Now, you fear, via the acquisition of CML, they will be able to offer the kind of service that you described with respect to Avis, and that because of the fear of lack of support for switching the software interface, a terminal manufacturer such as yourself would be effectively frozen out?

Mr. SANDERS. Yes. There's a good example in the type of communication interface called SDLC. This is a very good example, and very pertinent, and one that they are in the process of using.

SDLC is a new communication interface that is almost designed for remote job entry, or long transmissions of data. There was a standard communication interface that was designed by the industry. It was called ADCCP. It was a much more effective interface and the—all of industry was working with Mr. McCloskey's CBEMA—to arrive at a good industry interface.

But like every other standard that industry has tried to develop, at the last minute IBM switches to one it's been developing on its own. This is SDLC.

It's almost like the standard, but not enough. Now in order to survive, every manufacturer must know what the SDLC interface is. So there is an interface card that is designed, and you design that

interface card right up to the point of the last bit of information that is yet to be released.

The exact last detail that can be arbitrarily switched is yet to be released so we have a little section of the card that is yet to be designed. By having the design in that stage we are able to plug in the components that are missing when IBM finally decides to do this.

Now I have recently found out that all these details that we are missing, they have been teaching to their service people for a period of at least 12 months. And yet they absolutely refuse, and we have submitted this over many legal requests to them, to supply that information to us.

This is what I call capricious—the capricious management of this interface—for their advantage.

Mr. O'Leary. Once they release it, how long will it take you to catch up?

Mr. Sanders. I believe, by a great deal of management, we can catch up in a few months. In the case of the 3270 it took the people 2 years to catch up with the interface switch. It depends, really, I think on how well we're able to do this. In the past, when we weren't expecting it, it took us a long time. I think all the manufacturers now will tend to minimize that time. But even with a great deal of special management attention, it is still very much of an unfair advantage.

Mr. O'Leary. In 1956 the Justice Department sought to curb IBM's power in tabulating machines and they managed to make a quantum leap in data processing. I take it now you see the same thing occurring by virtue of this acquisition?

Mr. Sanders. I think that the breakup and the action on IBM needs to be aimed at the way the industry is going to be in the future. For example, I would like nothing I say to take away from the excellent recommendations that were just made with respect to the component industry.

But it is important to, I think, understand the way that the industry is going to be in the future, and to keep IBM from giving up the thing that is becoming obsolete in the marketplace to going on to grabbing what is just beginning to emerge.

And this is what we are afraid is happening.

Mr. O'Leary. Thank you. I have no further questions, Mr. Chairman.

Senator Hart. Mr. Chumbris?

Mr. Chumbris. We have no questions, Mr. Chairman.

Senator Hart. Thank you, Mr. Sanders. I hope you can make that appointment. Let us take a 5-minute recess.

[Whereupon, a brief recess was taken.]

[The following was received for the record:]

MATERIAL RELATING TO THE TESTIMONY OF ROYDEN C. SANDERS, JR.

Exhibit 1.—*Prepared Statement of Mr. Sanders*

I. INTRODUCTION

Sanders Associates views with concern the announcement made July 3, 1974 that IBM plans to enter the domestic satellite business through acquisition of 55% of CML Satellite Corporation.

CML has been approved by the Federal Communications Commission to start domestic satellite common carrier services. IBM, with its great financial

resources and marketing power, can, through the CML acquisition, achieve effective control of the integrated business systems market, a market more than double IBM's current market, as well as a large portion of domestic broadband communications. This statement will demonstrate how this will be accomplished.

The evolution of the Information Handling Age, in which virtually every segment of society has both the need and the means to grapple with the information explosion, has occurred as a result of the confluence of electronics and American-style marketing. No single organization epitomizes both the positive and the negative aspects of the confluence better than IBM.

Electronics is the common denominator for the media of information and for the devices which translate those media and their messages into useful human knowledge. The force of marketing has caused old methods and institutions to become committed to the new electronics way. The transformation is here, and the marketing power is in place.

The one link missing in the merger of disciplines necessary to forge the complete information handling instrument was emphatically supplied on July 3, a sleepy afternoon in Washington, the eve of a four-day weekend, with a government focused on many divergent problems and the FCC in the throes of reorganization: IBM announced its intention to enter the common carrier communications field via the acquisition of a controlling interest in CML.

In that one simple stroke, the entire information handling market was encapsulated.

Satellite communications systems have the potential of becoming the least expensive method of communications between computers, remote terminals, and other business devices. Although IBM will not control the only satellite communications system, it alone will possess the resources to control the $110 billion domestic market that encompasses business equipment, data processing and business communications—the total market for integrated business systems.

This market is made up of systems and products which collect, process, store and disseminate business information. IBM already has a monopoly in the data processing industry. If IBM controls business-related communications, it will be in a position, under cover of the complexities of satellite communications technologies, to control the interaction of all elements attached to the system. Competitive business systems manufacturers and independent terminal suppliers will be forced to conform to IBM "standards". These standards will be disclosed in the time frame IBM desires, when IBM has a product line designed and deliverable, while its competitors, without equal knowledge of the IBM standards, can only then begin to develop competitive products.

IBM has demonstrated an outright monopolistic intent in the peripherals and terminal fields, by capriciously manipulating interfaces and device support techniques. It must be prevented from similar activities if communicatons are added to its marketing resources.

This paper does not treat the ramifications for foreign commerce brought on by IBM's latest move. The domestic problem is sufficiently severe to warrant concentrated attention at this time, but the foreign aspect must eventually be explored.

In this paper, some of IBM's practices and their anticompetitive effects in the data processing world are described. The emerging business systems communications market is shown to present opportunities for predatory practices that are parallel in nature but much greater in scope. The paper concludes with recommendations for avoiding those effects.

II. THE EMERGING INTEGRATED BUSINESS SYSTEMS MARKET

IBM's origins in information handling stem from its early occupancy and domination of the electromechanical card-tabulating market. A 1934 conviction, upheld by the U.S. Supreme Court in 1936, for monopolization and anticompetitive practices in the punch card machine field did not deter it from achieving this domination. Likewise, Justice Department litigation, commenced in 1952 leading to a 1956 antitrust consent order relating basically to its tab card activities, did not impede its switch into the next generation of information handling—electronic data processing.

The progression into successive generations of EDP systems has not been without minor antitrust casualties and nuisances for IBM. The premature announcement of system 360 in 1964 ultimately precipitated private litigation by Control Data Corporation, Telex, and others, which has so far resulted in the dropping of less than $500 million in damages—about four months' monopoly

profits by some estimates—and some now hollow restrictions. The Justice Department, in 1969, instituted yet another antitrust action and is hard-pressed to begin trial this fall.

The setting is ripe for another settlement which will be next to meaningless once IBM is underway on its new tack—total information handling systems from inception through communications to reception and back, with processing interjected at steps along the way. If the final judgement in the Government litigation ignores the portent of this latest adroit, but familiar swing, many new and modified markets will be foreclosed in their infancy.

The dollar volume for the integrated business systems communications market in the U.S. alone in 1975 would add the staggering total of $20 billion in straight communications services, and about $10 billion in the substitution of electronic message techniques for traditional hard copy deliveries such as mail, to the current data processing base.

Data processing, communications, and "mail" currently interrelate within networks of computer systems. The next major phase in the evolution of data processing will be distributed systems in which networks of central computers and intelligent terminals will require an extensive communications capability. The principal deterrents to more rapid growth of distributed processing have been expensive long distance communications and IBM's unwillingness to push this capability until they had the technology and strategy to control the terminal market. A satellite system will give IBM the missing ingredients, low cost communications and the means to absolute market control.

With the development of large networks, terminals submarkets are the fastest growing parts of the data processing market. With IBM's strategy of moving from relatively simple hardware interfaces to the use of software to control device support, IBM has the power to effectively disable all devices manufactured by independent companies.

Communications has been controlled domestically for many years by AT&T. Clearly the FCC has worked diligently to harness this giant. The FCC has allowed competitive entrants to offer specialized communications, especially in data and facsimile, on an inter-modal basis, using packet-switching, microwave, and satellites. Before July 3, 1974, however, no entrant had sufficient capital or marketing base to move aggressively forward on all fronts. IBM has the capital and marketing base and has been proven very aggressive.

If the 1969–1975 growth rate for total integrated business systems, including communications, is projected to 1980, a total market of $250 billion is estimated. This is a very worthy target for a company which has vowed to maintain dominance in information handling, and now is equipped to serve every major segment.

IBM will attempt to capture the market in spite of the current government antitrust case, or perhaps as a result of it. A familiar pattern could be followed. Portions of IBM's current business, obsoleted by the shift in technology towards distributed processing, could be abandoned in favor of the new endeavor of communications. Promises to behave in its "traditional" market could be exchanged for permission to compete in a new market. The marketing base would not be dissipated, however, and the fundamental pressures would not be relieved.

III. THE COMPUTER ENVIRONMENT

An examination of Sanders' experience in one submarket of the computer industry will illustrate what could happen in the integrated business systems market if the IBM/CML merger is allowed.

The requirements for distributed processing systems involving vast numbers of terminals is growing rapidly. At present each computer terminal is connected basically to its own computer. This is similar to the situation in the telephone industry years ago when each company was a private exchange, not connected to any other, and, as a consequence, of very limited use. Soon, however, terminals will be required to selectively address other business equipment networks, and new services will evolve which will be fantastically useful and extremely inexpensive.

In order to allow interconnection of computer terminals and other business systems there must be, in addition to low cost communications, meaningful device support standards or interfaces agreed to and adhered to by IBM and others. Further, it is absolutely necessary that this come about in a timely manner.

Until the mid-60's in the computer market, the submarkets for terminals and for the peripheral devices were quite small. IMB's major growth prospects were

with computers. Sanders Associates and other independent terminal and peripheral equipment suppliers entered into competition with IBM in the submarkets. Market penetration was relatively swift, and many innovations were introduced by the independents.

This penertation and the emergence of distributed processing caused IBM to turn the full force of its predatory marketing practices on the peripheral and terminal submarkets. Without technical superiority, only anticompetitive moves by IBM could continue its dominance.

Sanders' experience illustrates those tactics, and what could happen in the integrated business systems market.

Sanders Associates builds display terminals, using keyboards and cathode-ray tubes, to allow human communication and interaction with data processing systems. These terminals can be used in a conversational, or interactive, mode, or to feed or accept data in a batch process.

Most Sanders terminals were connected to IBM computers, because the latter saturate the market. The interface for all interactive display terminals on IBM 360/370 computers was the 2260 software and hardware interface. The Sanders terminals were acknowledged as superior to IBM's terminal product line by IBM's top management; in the more sophisticated segments of the industry, most technological innovation has come from independents like Sanders.

To maintain its role as an innovative leader, Sanders announced its new 800 line of intelligent displays designed for distributed processing in mid-1971. Other independents announced similar displays. At about the same time, IBM announced its new 3270 display which was essentially similar to the Sanders terminals introduced in 1965. The 3270 incorporated many features of earlier products, but was not an intelligent terminal and seemingly presented no real threat to the independents. IBM began deliveries of the 3270 in the fall of 1972. Sanders' sales and order trends continued to be favorable.

In the fall of 1972, IBM announced virtual systems software in connection with its new 370 computer systems. Early in 1973, IBM let it be known that the 2260 device support, through which many of the independents' terminals work, would not be "supported" under the new virtual software.

This announcement meant that users of the IBM 2260 displays, and competitive displays, including Sanders', operating through the 2260 interface, could not optimally utilize the new virtual systems IBM 370 computers. Users either had to drop perfectly adequate, older terminals or recently acquired intelligent terminals or forego the advantages of virtual systems software.

The independent interactive 2260-compatible terminal market withered almost overnight as a result of this capricious manipulation of device support by IBM, despite the superior performance and lower cost of the independents' displays.

IBM apparently concluded that it could not attain its goal of increasing its share of the display market with its new 3270 display and simply changed the track gauge.

IBM's display strategy was successful in a related aspect. IBM refuses to disclose interface specifications at the time of a new product announcement and, in fact, withholds the information until it makes its first shipments. Competitors were not able to deliver 3270 compatible displays until early 1974, almost 24 months after IBM's initial 3270 shipments, (the length of time required for design and engineering) and almost three years after IBM's 3270 product announcement and associated order taking.

To further confuse the marketplace for users and competitors alike, IBM announced a series of hardware and software products in the same time frame. All impacted the interactive market, and were technically vague, with varying delivery schedules.

IBM uses the timing of product announcements and interface disclosure to achieve two goals. First, to obtain a two-to-three-year lead in the marketplace, thereby making their product life at least that much longer than their competitors. This time leverage in a lease business is the difference between significant profit and, at best, marginal profit for any single product life cycle. Second, to chill the market for competitors' products by putting its competitors in the position of having to attempt to persuade customers that they can follow IBM without the specific technical knowledge to explain how.

The tactics described in this section are within the scope of IBM's stated policy. Under the guise of allegedly advancing technology, IBM is able to increase market share without a superior product. If allowed to nurture this strategy in the communications area, the results will be disastrous for competition. The market will be cornered.

IV. SCENARIO OF THE EFFECTS OF IBM CONTROL OF CML

Given the history of IBM's predatory marketing practices, it is possible to postulate some of the effects on data processing and communications if IBM is allowed to carry over its past practices into the new and larger world of satellite communications, without appropriate safeguards for the public interest. This situation would be in contrast to current common carriers whose systems are transparent or neutral in relation to the devices attached to them, and whose systems simply carry information without processing it at any point.

IBM's data processing activities would be favored, especially in a distributed processing mode, by discriminatory services, cross-subsidation, and improper pricing of common carrier/computer services. It might be possible under the FCC's hybrid service rules (47 C.F.R. § 64.702) to offer a bundled package. IBM could provide equipment designed to optimally interact with the communications system because only IBM would be in a position to totally dictate the relation of the systems. Installation and maintenance performance for IBM EDP customers as well as more timely response to initial installations and requests for outage corrections, could occur. IBM has been known to switch costs for one device to another. If this practice is carried into the communications realm, an even greater undue competitive advantage will occur.

IBM has every motivation to influence the design of the satellite network in such a way that it can be utilized for IBM's massive return to the computer services market. A satellite communications system can be designed to favor a particular approach to nationwide computer services. IBM is presently restrained from operating so-called service bureaus, but that restraint can be obviated by rendering ineffective the current service bureau concept.

IBM has already concentrated on distinct industry data processing applications, such as insurance, transportation, retail point-of-sale, and the like, with some of its software and product lines. These industry groupings represent service networks already in place, merely waiting for IBM to "field enable" the networks components so that they may optionally utilize the new communications offering. The erection of interrelated data bases within these industries is all that is necessary to sound the death knell for today's service bureaus.

On the surface it would appear that the entry of IBM into the communications business might be beneficial because to some IBM presents the first technically competent, well-financed organization to compete with the Bell system. However, the confrontation of these two giants will ultimately lead to a division of the market along non-competing service lines. The abatement of competition will make losers of the customers and the public. Smaller manufacturing and service organizations presently endeavoring to do business in this field will be severely damaged in the early struggle, with bleak prospects once the division is established.

AT&T has a huge installed plant for communications. However, most of its capacity is geared for slow speed, low bandwidth communications. The new information handling market will be most efficiently and economically serviced by high speed, high bandwidth communications; IBM will make that market, by forcing its business and data processing product lines. The growth markets of distributed data base management, facsimile transmission, and many other services, all demand wide transmission channels.

Bell controls the current local loop plants to an overwhelming degree, and would continue to. However, with several hundred relatively inexpensive small earth receiving stations, most of the integrated business system market can be blanketed without the requirement of using established common carrier local loops. The technology has been proven to allow "local distribution" through the combination of small earth stations, dedicated cable or microwave, and local internal wiring on equal or better price/performance with the current local telephone system plant. IBM can thus neatly by-pass Bell. Incidentally, by offering this service with its own local drop, and by offering an automated voice/data PBX which is being actively marketed in Europe and which is installed in this country on an "experimental" basis, IBM could eliminate much of the current local business traffic, Bell and otherwise.

AT&T is further restrained by virtue of its own domestic satellite licenses. As a condition of allowing Bell to participate (planned now in partnership with GT&E), the FCC proscribed data and other "specialized" traffic for three years from onset of operation on the AT&T domestic satellite. Besides, under its own 1956 Consent Order and under FCC rules, Bell is prohibited from offering data processing services or equipment not available to support a tariffed com-

munications service. Will the AT&T Consent Decree have to be reopened to accommodate this latest turn?

AT&T lacks equipment to combat IBM. Its one "data processing" product entry—the Dataspeed 40® terminal—was almost instantaneously eclipsed by this July 3rd announcement. Bell will have nothing to answer the variety of applications-oriented terminals and distributed processing systems IBM has already started announcing, such as the 3790.

Neither, unfortunately, will the independent terminal manufacturers, but for a different reason. For some time now, IBM has been unilaterally developing telecommunications software and transmission protocols. The satellite system, in whole or in part, will utilize these software products. None of the competition will be in a position to have a product line that will efficiently interact with the communications system. The independent interactive display terminal manufacturers have already seen the anticompetitive effects of such tactics in IBM's manipulation of terminal device support. If this policy is expanded by IBM to the communications media also, the effect on independents will be devastating.

IBM has maintained a bundled pricing policy whereby it quotes a single price for hardware and software and related support.

They could thus offer an integrated business systems package. For the past 18 months IBM's statements have increasingly emphasized "systems", apparently in an attempt to incorporate communications as a part of their business, as well as to justify the difficulty of identifying the interface to allow interconnectivity.

The IBM/CML statement that they "have no plans for public-switched network services" is meaningless. For example, there is absolutely nothing of a regulatory nature that precludes a domestic satellite carrier from offering switched data services. Therefore, CML and its spokesmen can represent that switched network services are not planned and at the same time they can be actively developing a switched network in concert with their owners, IBM and COMSAT. Clearly this type of activity gives great advantage to IBM and places its competitors at an insurmountable disadvantage.

To summarize, IBM will have the advantage of timing as it relates to product announcements and changes, technical interface criteria, and communications costs. These advantages, when added to IBM's already overwhelming hardware and software advantages will give IBM far greater market control over the computer/communications business than it can exercise today. Those charged with controlling commerce must understand the ramifications of adding the dimension of communications to IBM's repertoire.

V. RECOMMENDATIONS

The IBM/CML acquisition should be denied because the potential for market foreclosure and anticompetitive maneuvering is far too certain to balance any potential positive effects.

In the event those in Government in a position to stop this merger do not see fit to follow the recommendation above, consideration must be given to a drastic restructuring of IBM and the adoption of ironclad conditions precedent to its entering the communications field. These conditions will insure the interconnection of all competitive offerings—data processing or communications. Complete divestiture is warranted to dissipate the awesome power that has been accrued. Subsidiary relationships will not provide adequate protection.

When IBM's market power was localized in the traditional data processing industry, several recommendations were made to combat its predatory practices and reduce its overwhelming market power. Representatives of some of the competing manufacturers of data processing equipment presented views to the Department of Justice on just how this should be done. Industry commentators have put forward their suggestions. Some of the thoughts included breaking the IBM structure into many separate corporations, unbundling of products and software, placing judicial restraint on some predatory marketing practices and making mandatory certain interface standards for peripherals and terminals. These suggestions must now be re-examined in the light of this latest turn of events.

The final plan must create an environment of transparent or neutral interconnection between all hardware, software and communications elements, so that there can be true competition at each workable level. Vertical integration

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should be eliminated to reduce the kind of evils uncovered in the Western Electric-Bell relationship. The competitive procurement requirement for domestic satellite licenses must be reinstated.

This is the crucial moment for such decisions. Action must be taken prior to the establishment of IBM's new beachhead. Only in this fashion will the public interest be safeguarded. This is not a call for a utopian solution, but is a statement of the plain truth that to enter this new era with out realization of the factors stated herein, and without means to contain the harms identified, will forever stifle competition in the total information handling market. The decisions will be difficult and implementation of plans even more so, but there is no substitute for coming to grips with the situation now.

Senator HART. The committee will be in order.

Our concluding witness today is the president of the Computer Industry Association, Mr. Dan L. McGurk. Mr. McGurk?

STATEMENT OF DAN L. McGURK, PRESIDENT, COMPUTER INDUSTRY ASSOCIATION, ENCINO, CALIF.

Mr. McGURK. Thank you, Senator Hart. I won't go into any biographical information because I previously submitted that with my testimony of last year.

I appreciate the opportunity to again appear before the subcommittee. Before I go into my testimony I'd like to set the record straight on just one point.

It is not a principal objective of my employment to make public attacks on IBM. Unlike Mr. Katzenbach, who is paid to defend the so-called International Business Machine Co., I'm not employed by anyone.

I serve as president of the CIA without pay. You've already heard testimony in this set of hearings that describe the structure of the marketplace and some of the problems for users and competitors alike that are created by the dominance of one firm in this important industry.

I would like today to indicate from a practical and parochial viewpoint what the effects of such market dominance are to a competitor in the industry.

I'd also like to point out some of the problems inherent in our current legal system and indicate some criteria necessary to solve this particular problem and make a modest contribution to the task of devising more appropriate legislation.

There are two important constraints on the way in which a smaller competitor must operate in the data processing industry today.

In the first place, he must adjust his total business strategy to take account of the fact that he must compete in an environment which has been structured by the dominance of IBM.

This entails his acceptance of a set of conditions within which he must operate if he is to have a successful business.

In addition to that, however, a small competitor finds it necessary to make realtively rapid and sometimes major changes in his business strategy when IBM decides that the environment is due for a change.

In other words, not only is the competitive environment a difficult one but that environment is subject to change without notice when IBM's corporate objectives are not being met within that environment.

This makes the business strategy of a smaller competitor extremely difficult, and the number of failures indicates that few are successful.

As I'm sure you have become aware during the course of these hearings that the computer industry is an extremely complex and diverse one.

Data is hard to acquire and interpretation is not simple. As an illustration of that, I'd also like to set the record clear on Mr. Chumbris' questions of yesterday concerning some of the material submitted by my colleague, Mr. Biddle.

He pointed out that in a chart that was submitted out of Judge Larson's decree that IBM showed a world market share in 1956 of 42 percent and Sperry Rand 51 percent.

What we failed to notice was—and this is an illustration of the difficulty of understanding this business—that was a chart of total revenues in 1956.

If you recall at that time, IBM did not sell any of their equipment. So for the IBM revenues that was pure lease revenue—rental revenue.

For Sperry Rand it was almost pure sales revenue; for in the next paragraph of that statement by Judge Larson it says in 1956 IBM shipped 85 percent of all new business. At the end of 1956, IBM had 75 percent of all ADP systems outstanding.

So, you see, the facts are there but the interpretation and understanding of them is tricky. In fact, IBM never had as low a market share of 42 percent except on a revenue basis for that year—which does not represent the real market power.

The large marketplace is characterized by a very definite customer demand for rental rather than purchase of this important capital equipment.

Although there are specialized marketplaces where purchase is the more likely means of equipment acquisition, the vast bulk of users is accustomed by a long period of IBM market-control to leasing their equipment on a month-to-month basis.

What this means for a small company attempting to grow was shown by Mr. Collins earlier today. A second major environmental constraint to a small competitor in this industry has to do with the enormous weight of software which overhangs the marketplace.

By avoiding significant software standardization IBM makes sure that its enormous resources devoted to creating new software make it impossible for a competitor to match it in the amount of software available.

I remember particularly a point in time at Scientific Data Systems, where I used to be employed, a small general purpose computer manufacturer, when we had successfully been in business for about 5 years.

Annual revenues were between $50 and $100 million. We were very proud of having accumulated a vast store of software which we estimated had cost almost $30 million.

Then we found out that IBM had invested in its 360 operating system alone over a billion dollars. Even assuming that we were twice as efficient in software creation—which we were sure we were—that's a very high barrier to cross when convincing a customer that your offering is a viable alternative.

New firms in many industries are able to compete because of significant technological innovation which creates a market for a newly designed product.

Because of IBM's enormous market power in the industry such innovation must be limited to doing just what IBM does in some better or new way.

A new widget to improve the data processing function cannot have a broad market acceptance until IBM legitimizes it by coming out with a comparable widget itself.

Until that happens, any inventor of such a widget has to have his marketing force spend most of its time explaining why the widget is good; why IBM doesn't have it; and whether or not it will make a system encompassing it noncompatible with the standard of the industry—that is, IBM.

This necessity to match IBM on a functional basis is one reason that there has developed an industry of plug compatible peripheral devices and, recently, even central processing units.

Another fact of life for a smaller competitor is that IBM, by its size, has the ability to, and in fact does, completely blanket the worldwide computer marketplace with its sales force.

This doesn't only mean that more opportunities are available to IBM, but it also means that many large corporations with offices or plants around the country and the world have a strong predisposition to go to IBM to make sure that if they adopt one manufacturer throughout their company they can be assured of sales and service at all their locations.

In order to combat this problem, marketing strategies of small competitors must devise a way to focus their efforts by geographical or industry application in order to be able to offer anything approaching such total coverage.

The net result of the structure of the environment described here is that a small competitor has to locate either a market where IBM has not focused attention—normally because it's too small to be of any great interest—or to live with the environment structured by the dominant company.

Most firms attempting to grow in the computer industry have started out with the first strategy, and then in order to expand their market have been forced to live with a difficult environment created by the computer industry.

But it doesn't end there. Having developed the strategy which might expect a small competitor to exist and grow, he has to accept the fact that the environment can be changed unilaterally by the whim of IBM.

It matters very little if that whim comes about because the company or some group of companies have been successful and, therefore, deliberate action is taken to limit their growth; or whether some other cause creates a corporate need for IBM to change its practices in the marketplace.

In either case disaster can result. If a mouse has learned to live in a stall with an elephant, whether the elephant steps on the mouse intentionally or not it hurts just as much.

One of the solutions to the leasing problem devised in the late 1960's came about through the creation of a number of independent leasing companies that have been discussed earlier.

Based on the historical relationships between IBM sales prices and rental prices this appeared to be a relatively viable business.

On the introduction of new machines, however, and after the leasing companies had begun to impact IBM's plans, IBM drastically changed the relationship between purchase prices and rental prices, thus making the leasing industry relatively uneconomic.

Shortly thereafter IBM also introduced long-term leasing plans which had previously been offered by their competitors.

Had they been constrained by the consent decree of 1956 from offering such plans until 1966, but still not offering them for 3 years, it wasn't until 1969 that such an offering was made.

This did create a new opportunity for the leasing companies—long-term full-payout leases—but it did at the same time destroy a small competitive advantage which the competitors of IBM had been able to create, given the previous environment.

In fact, IBM long retained the price umbrella for all of their competitors, carrying out a policy of never reducing the prices of currently available products.

Although this policy still appears to hold in theory, starting in 1969 and 1970, IBM introduced new products with new product numbers that turned out to be technically indistinguishable from older products, except for the changed model number designation and a sharply lower price.

This is one of the pseudoinnovations which Mr. Biddle referred to yesterday. Another such innovation, while I'm on that subject that I would call a pseudo-one, is the changing interface between the peripheral units and the central processor.

The integrated file adapter and the integrated storage control were introduced by IBM as technological advances.

What they really were, were moving the controller into the main frame and out of the way of the peripheral plug-compatible market.

IBM announced in 1964 a compatible set of systems which had a common interface to peripheral units. And that was the basis in which the plug-compatible market was established.

But these changing interfaces made that standard, which had been introduced and announced by IBM, out of date, and therefore caused great havoc among this new industry which, as somebody earlier mentioned, was the first new real competition to IBM in a number of years.

One can go on: Changing specifications for media; stopping support of previously supported software; eliminating software interfaces in new software releases.

However, it seems to me that this whole area can best be proven by the following tale: The Computer Industry Association has identified a potential problem in the future in the area of data security.

It is clear that it will be necessary and important to provide means to users to prevent unauthorized access to their data files in order to provide privacy and confidentiality.

The CIA has suggested that one dangerous possibility in that regard is the creation by IBM of a hardware-software privacy lock which prevents other manufacturers from providing access to, or compatibility with, IBM systems.

We talked about this theory in many forms including National Bureau of Standards seminars, National Computer Conference panels, and so forth.

Although there has been some argument about our fear and about our concept, the interesting thing is that there's never been any comment that IBM wouldn't or couldn't do that—that it was in their best interest.

In other words, industry leaders are so used to the dominance of IBM in creating and changing the environment in which they operate that they don't question that IBM could and would manipulate it in that sort of way.

The point is that the rules of the game are difficult. But if you start to win they change.

I'd like now to turn to the question of whether or not our current laws and legal processes can solve the problem of IBM's monopoly power and dominance as outlined both in my paper and other evidence presented to your subcommittee.

A look at the history and status of the Government's antitrust action against IBM could be instructive in that regard.

The Justice Department has sued IBM for Sherman II violations in 1932, 1952, and 1969. The latest effort, 5½ years old, was due to go to trial in 3 months.

I understand that this morning that was continued until next year. Many observers believed that the schedule would not be made—they were right.

Even if that schedule were to have been met and IBM were to be held in violation of the Sherman Act it would be many years—up to 15—before the solution which the Justice Department would like to impose would be developed, screened, analyzed, adjudicated, negotiated, and implemented.

At the very best, this means that a solution is created which solves the problem identified 10 to 20 years previously.

In a high-technology, rapidly changing industry this is obviously unacceptable. Justice delayed is justice denied; and justice delayed is, in this particular case, if it is to happen, to be applied to a situation from ancient history.

Given the legal resources of a large monopoly, the necessity to operate within our current laws, and with the safeguards of our current legal system, it appears that reasonable speed in the solution of a monopoly problem is not possible today.

The problem of a timely solution can be divided into two parts: The first is, is it possible within our current laws to establish a violation of the Sherman and/or Clayton Act on the part of a dominant company in a reasonable period of time?

It's clear that one purpose of S. 1167 is to solve that problem by establishing criteria more easily proven.

I commend that concept, if not the specific criteria of that bill.

The second problem is, given the finding of monopolization, is it possible within our current structure to establish and carry out a relief plan that will solve the problem?

From past history one has to assume that the courts, upon prosecution by either the Federal Trade Commission or the Justice Department, have an automatic bias toward regulation.

It seems quite straightforward and easy for a court to lay down a series of injunctions, either by court order or through a consent decree, which regulate specific practices or business conduct.

From the few instances in which a solution has been found through restructuring or divestiture we must assume that our current system is much less able to deal with any solution other than regulation.

I submit that it's patently clear that current laws do not provide a timely solution to establishing violations and correcting structural problems.

In the particular case of the computer industry, what criteria should a solution meet?

The first and most important is that the solution should break the market power of the dominant company or control it in such a way that it is deleterious neither to computer users nor other competitors attempting to supply alternate products.

This includes insurance that IBM or its remaining entities do not have the unilateral ability to create and change the environment in the marketplace.

To accomplish this it would undoubtedly be necessary to eliminate or sterilize the $4 billion in cash assets that stand behind IBM's enormous financial power in market control.

You notice my number is a little larger than some of the other peoples because theirs was as of the end of last year, and I have adjusted it for the cash infusion since then.

Any solution would have to lead toward an interchangeability of competing systems. This implies a rigorous industry effort on standards and interchangeability in both software and hardware.

Only if such compatibility were established would it be possible for competing entities to offer comparable products and services to all computer users.

Assuming that a solution did not create a large number of competing entities in place of IBM, it would be necessary that no company could dominate the injection of technology by surprise announcements of new interfaces between various pieces of hardware and between hardware and software.

Next, any solution would have to encourage, or at least not badly discourage, entry of new firms. If we define a competitor as a firm that is 1 percent of the size of IBM then there have been no new competitors in the computer industry for at least 10 years.

If we define success, as many industries do, as 10 percent of the market, there has never been a successful competitor.

The computer industry today contributes a significant dollar amount to our balance of trade. A solution must not change, and in fact should be designed to improve, the positive balance of trade created by the computer industry.

Perhaps most importantly, any solution should take advantage of the forces of free enterprise and managerial entrepreneurship which are available to this economy.

And last, a solution should be implemented this century if not this decade.

The boundaries within which a solution will be found are the restructuring of IBM into several competitive entities, as requested by the Justice Department; the regulation of IBM's business and business practices in a form comparable to the consent decree of 1956; and a whittling of IBM's market share through a combination of regulation and divestiture, looking forward to a time when more competitive

conditions would exist in the industry—at which time the regulations could be removed.

It is my understanding that witnesses tomorrow will cover some, if not all, of these possible solutions. But I would like to comment on them in advance.

Regulations through court order, whether arrived at by a judgment or a consent decree, would lay down a set of rules under which IBM would have to conduct its business in the future.

The rules devised would be intended to guide and control IBM's market practices and policies for the benefit of users, and to permit a viable competitive industry to develop and prosper.

The rules would undoubtedly include some restraint on the permitted contractual terms for IBM to do business, perhaps, for example, prohibiting leases of greater than a duration of 1 year.

It would also include rules under which pricing could be set and technological changes introduced. The Computer Industry Association submitted a recommendation to the Justice Department 18 months ago for just such a set of rules.

However, our goal at that time was that those rules would be to regulate the industry only until the Justice Department case was completely settled.

There is ample precedent for this kind of action in the U.S. economy. Where problems of natural monopoly or unlimited economies of scale have arisen in the past, this solution has been often used.

On the other hand most of the current trends within both the executive and legislative branches of the Government are directed away from such regulations.

In fact there are numerous efforts afoot today to deregulate some of the regulated industries.

Most schools of thought, liberal or conservative, tend to believe that the advantages of the American free enterprise system are reduced insofar as such Government regulation is undertaken.

The second node of the three nodes of possible solutions, I call "whittling." It's a combination of temporary regulatory provisions combined with strictures that require reduction in market share to some predetermined level or divorcement from activities—such as terminals or software—which may represent the largest future growth areas in the industry.

The combination of these two look toward the time when the market share goals have been reached and the regulations are then removed.

Since this solution has the expectation of removing all regulations, either after a given period of time or when a specific event occurs, they are, to conventional economists, more attractive than indefinite regulation.

In addition, since it insures an expanding market share for competing companies, this plan has considerable attraction to those companies currently attempting to capture an increased share through the working of a free enterprise system.

Most of the largest companies in this industry believe their interests would best be served by such a solution.

On the other hand, the consent decrees won by the United States against IBM in 1934 and 1956 were of such a kind.

Since they have been largely ineffective in achieving their objectives there are many within the industry and within the Government who are not sanguine concerning the likely results of such an action.

In an industry as dynamic as data processing it would require an inordinate degree of foresight to be confident that the expected results could be achieved.

I think Mr. Sanders' presentation just prior to mine, where he pointed out that if you solve the problem in these terms today, the jump into a total network of communications and computing—where what we have been talking about here as the systems lock—becomes a total information lock—would tend to indicate that if we solve today's problems without considering that, it wouldn't solve the problem in the longer run.

This whittling solution is clearly the most penalizing one to the corporate entity of IBM. If it is successful in achieving its objectives the plan undeniably rewards success by insuring that growth will be zero, or negative, in the future.

The restructuring solution currently advocated by the United States, according to their filings with the court, is intended to go to the heart of the market power of IBM, splitting it into a number of competing entities.

Since none of these entities would have the image, installed base, resources, or monopoly position of IBM, the assumption is that they would vigorously compete with each other as well as with other firms in the industry and thereby restore open competition without regulation.

This restructuring would make the objectionable market practices less likely, since their effectiveness depends upon the total market power of IBM.

Without such power the encouragement of renting, lack of information on interfaces, tie selling, refusal to deal, and unilateral establishment of standards, would be more difficult, if not impossible, to carry out.

The disadvantage of this solution is that the increased competitive atmosphere within the marketplace, and the probable lowered cost to the user, could put the survival and viability of other main-frame firms in serious question.

By leaving the installed user base intact, even though split among several firms and dedicated to what is now IBM equipment, additional market share for CDC, NCR, Honeywell, Univac, and Burroughs would be almost as difficult to achieve as it is today.

Other factors in the industry would, of course, have additional potential OEM opportunities and OEM competition from the new entities.

Most economists, I believe, would tend to support the Government solution as the one most likely to bring the advantages of the free enterprise system to the computer market.

A combination of enlightened self-interest and doubts concerning some of the projected results of such a restructuring causes many industry executives to prefer either of the other two nodes of the solution matrix to the restructuring one.

On the more general topic of your legislation, Senator, I'd like to advance a few modest proposals which might be worth considering as additions to S. 1167, or as part of a new piece of legislation.

My comments are focused toward attempting to have a solution to the concentration problem assisted rather than opposed by the considerable entrepreneurial resources available in our free enterprise economy.

In the first place, any statute on the subject should establish very clear criteria of concentration and/or monopolization.

Today it's almost impossible to get a clear statement of what constitutes a violation of section II of the Sherman Act.

Such a criteria could easily be based on market share. Without a market share of approximately 30 percent, held for a reasonable period of time in a relevant marketplace, there cannot be market power.

At the same time a market could have a "four-firm concentration ratio" of 100 percent with no firm having as much as 30 percent market share, which would indicate that the criteria is not overly restrictive.

If it can be proven that over 30 percent of a market is required to achieve economies of scale, there must be firm provisions that protect the consumer in such an unusual case.

The point is that the danger of monopoly is the holding of market power rather than something vague like "attempts to monopolize."

But wouldn't such a stricture create a strong disincentive to management? Why strive and compete if there is a mandated ceiling beyond which an enterprise cannot grow in the marketplace?

This is a serious and real problem. Monopoly or a significant power over the marketplace is the goal of all managers of free enterprises.

However, when such a goal is achieved the entrepreneurial energy is diverted to maintaining and extending the monopoly and avoiding prosecution by the authorities rather than creating ways of increasing service to customers.

As a consequence an alternate course must be devised which permits the entrepreneur to continue to compete, and creates greater rather than less competition.

I'd like to make an additional proposal in this regard, which should be analyzed and investigated as one possible idea on the problem.

The concept is that of a restructuring tax credit comparable to the investment tax credit. A publicly held company which divests of a subsidiary completely—setting up an independent company, transferring appropriate assets to that company, establishing an independent board of directors and distributing the shares to its stockholders—would be permitted to take a credit against income tax for the following 10 years.

The credit would be a percentage of the assets transferred to the new independent company.

In other words, a successful entrepreneur who reached the ceiling of his allowable market shares could spin off a competitive entity and achieve not only new ownership in a new enterprise for his stockholders, but in addition receive credit in his future income taxes for the economically sound act which such divestiture would represent.

Obviously, economic studies have to be made of the cost of such a proposal as well as the proper level of tax credit. I would suggest that the cost of such a program could be covered by a graduated income tax for corporations which increased to something like 65 percent rather than 48 percent for all taxable income over $100 million.

Obviously the exact percentages in dollars for these proposals will need to be closely scrutinized, but the concept is to tax to a higher degree those large agglomerations of power, about which social policy is properly concerned, in order to pay for the deconcentration instituted as an entrepreneurial venture by business managers.

There is an almost unlimited store of creative enterprise available within our economy. Let us structure an environment which harnesses that energy to achieve deconcentration by incentives rather than through the dead hand of regulation.

In summary, Senator, we have a real problem in the computer industry. Our current laws appear incapable of solving the problem in terms of either defining it or creating a constructive solution.

What we need is clearly a criteria for a solution and more creative ways in which such solutions can be structured.

Thank you.

Senator HART. Thank you very much. Mr. O'Leary?

Mr. O'LEARY. Let's assume reorganization has been made to make the industry more competitive. I'd like to get the reaction of someone with experience in the industry with respect to the feasibility of some of the ideas which have been propounded in terms of relief.

First, the idea which you touch on briefly in your statement about making four, or whatever the number, completely integrated computer system manufacturers. I am ignoring for the moment some of the related products which IBM might manufacture, on components, CPU systems, software, applications of software, and peripheral equipments. First of all, is it feasible?

Could we create a number of different integrated manufacturers out of the IBM facilities; and if it is feasible then would it be wise public policy?

Mr. McGURK. Mr. O'Leary, I think it's feasible. It's not a simple job. For example, as the witnesses yesterday pointed out, IBM has in Europe carefully arranged so that in each company there is a noninterrupted manufacturing plant; and I believe some of the witnesses indicated that they believe that that was a necessary economy of scale.

From my experience in the computer industry that is not a necessary economy of scale. The assembly and manufacture of computer main frames or peripherals is not a heavy capital investment industry.

The manufacturing equipment is not a heavy capital expenditure relative to the volume of manufactured product. The largest expenditure is test equipment, so I see no problem in organizing some number of companies around the plants that are currently in existence to have a number of integrated self-sustaining companies.

The exception would be the components division that was discussed by Mrs. Carlson. And as she pointed out: If that were spun off, that is a very viable, sound, strong entity.

I think it would be necessary that that be spun off in order for these other entities to be wholly integrated and self-sustaining.

I might say they wouldn't be completely balanced. They wouldn't be identical. Some might have a stronger capability for disk manufacturing, for example, where the others might have only an embryonic one, or a less capable one, or only a particular kind of disk.

Mr. O'LEARY. Some might make big machines; some might specialize.

Mr. McGURK. That would be one way to most easily do it. They could be fully line intergrated. You immediately ask the question, would they be viable competing across the line? You heard earlier that there are seven companies considerably smaller than any of those that would compete across the line.

Mr. O'LEARY. So you would have a company which manufactured components. I would assume that they would have to supply in nondiscriminatory terms components to these other computer systems manufacturers and you would have four or five or whatever the feasible number is.

Now, what happens to the remaining system manufacturers that are presently in the industry? Do they get cheated by the new firms which come out of IBM?

Mr. McGURK. One can't predict, of course, what might be the course of events. They would not be under the huge overhanging image of IBM, which is a very important factor in the marketplace.

Many of the system locks, the uses of the large market power that you've heard about here, would not be available to those individual companies.

I would expect none of them would be called IBM so I think that the better of those new ex-IBM entities and the better of the current systems manufacturers would survive and prosper.

I can't say which ones they would be. That would depend largely on management and, as in all enterprises, a certain degree of luck; but I see no reason why they couldn't be viable competitive entities.

Mr. O'LEARY. Mr. Collins talked before about the lower barriers to entry to the plug-compatible manufacturers who didn't have to offer the entire system to somebody.

Now, if you have four or five entities which came out of IBM and the remaining system manufacturers, have you really lowered the barriers for those people who want to specialize with respect to terminals, tape drive or disk drive, or do they still have the same problem? Is Telex any better off if you have 10 system manufacturers out there?

Mr. McGURK. Well, there's two sides to that, of course. One of the big advantages, when a plug-compatible manufacturer designs a product, the obvious first interface that he wants to have for that product is with IBM, because they are 70 percent of the market. So if you are successful in getting a compatible product you immediately have a very large marketplace.

The disadvantage is that as they have learned that compatibility can disappear overnight. In the situation were there are now four or five entities, there is no one 70-percent plug that you can design to plug into, but you do have some expectation that none of the others have the market power to completely unplug you; and if one does the other won't. But more importantly, were that to happen there would be a real need, and I really believe an important driving force, toward real standardization in the industry.

Now, standardization does not mean making all things alike. It means making the ability to connect together things and to interrelate data from one installation to another, if possible.

Standardization is like trailer hitches. It's not like designing cars alike. It's like having a standard interface so that if you build a trailer you can hook it on to one of several cars because there's a standard size ball hitch that you can attach to.

Now, it's to the advantage of both the trailer manufacturer and the car manufacturer to get that standardized.

More importantly, in our industry customers want the ability to exchange their machine data—tapes, disks, and so forth—between installations. The desire to have compatible media so that you can read a tape on the Univac machine that was written on an IBM machine is one of the few areas of real standardization we have today because the users demand it.

The standard is whatever IBM says, but at least it is a standard that by now is reasonably accepted. New media come along but the old media are still standard. I believe if the market was as fragmented as we're describing, with nobody with, say over 15 percent, there would be considerable pressure from the industry members themselves—and certainly from the users—to get a higher degree of interface standardization which would then make the easy entry markets like plug-compatible peripherals and terminals much more easily assured.

Mr. Sanders described his need to have an interface so that his new system will match IBM's. In an industry that is not so dominated, that would have been worked out by an industry standards group some time before.

Mr. O'Leary. The other way which is commonly discussed would be to take different functions of the fully integrated computer system manufacturer and see which of those can be pulled apart without disturbing the significant economies of scale that exist.

Now, what about the CPU and the systems software? Would those two things have to be under the same roof? I think the gentleman from Auerbach who testified the first day left the impression that sometimes you create the systems software and then build the hardware around that, which would lead to a possible inference that it should be the same.

Mr. McGurk. Let me just comment on that. The only company that I know that has done that is Burroughs. I think that IBM is doing that for their new system. That is, design the software first and then design the hardware to match it.

It is technically the proper way to go and it is, therefore, I think, important that a systems design organization— and we're assuming here that we have broken that off, the systems design and manufacturing the main frame as being a separate entity—have the ability and understanding to create the systems software.

That doesn't mean to say that it has to be indelibly bundled with the main frame. One of the—you might say—valid complaints of IBM in the plug-compatible arguments is that we create all of this operating systems software, we have to advertise it over everything, then these parasites come along and plug in and they don't have to develop that systems software so obviously they could underprice us.

That's true; but you ought to talk to a software house that tries to underprice IBM on their systems software. You can't get below zero and there's no reason that IBM could not charge for their systems software.

In fact, in Mr. Biddle's submission, one of his appendixes was a recent editorial by a leading executive and designer in a software house who said if IBM would charge for their systems software we would see all kinds of innovations.

There would be lots of competitive products in the systems software area. He says that. I'm not a software expert. It would seem difficult to me, but I don't see any reason why it shouldn't be left as a possibility.

Mr. O'Leary. What would your reaction be to a proposed reorganization which would say IBM has to spin off and make a separate corporation out of its component production facilities?

It gets to keep the production of the CPU and the systems software. It has to announce a standard interface when it changes or rewrites the systems software—say 18 months or whatever period is reasonable—in advance.

It has to spin off its manufacturing facility for peripheral equipment, and its maintenance organization, and its application of software. It makes separate entities out of those different functions.

Mr. McGurk. And its money?

Mr. O'Leary. What's your reaction? Is that feasible?

Mr. McGurk. Well, first let me say, Mr. O'Leary, that when one looks at the problems of the industry today and describes a solution like that, I believe that for the good of the computer user it's better than what we have today.

The trouble I have with that, personally, is that you would require continued intervention in the business world by enforcing regulations about standards by saying no, you can't diversify and have peripherals. You have kind of permanent strictures of these entities that you've created or if you don't have permanent strictures on them, I think the person that gets the cash and the systems design will, in a few years, create his own peripheral equipment and we'll be right back where we were. So I have problems with that because on the one hand you say that I'm going to have to keep my finger on this and these pieces for a long, long, time to come, or if I don't I'm not sure you solve the problem.

Mr. O'Leary. With respect to your tax credit—and it is an idea which obviously has a certain amount of appeal—I have two questions.

What is to prevent a firm from spinning off that which subtracts at least from its market power; and with respect to a firm like IBM, doesn't that generate more in the way of financial power?

In other words, the tradeoff being you have given them tax relief or money in order to spin off some assets. Doesn't that add to their power?

Mr. McGurk. Let me first say, Mr. O'Leary, I'm not an economist or a lawyer and I'm delving into industrial organization which is a common meeting ground of those two professions, though I'm over my head.

I throw this out as a suggestion which, I think, should be studied. Let me just say that to start with.

But my view of the answer to your question is that I make the assumption that the entity that is spun off must be a viable entity or the stockholders will be upset that they were given a worthless piece of paper which includes sufficient assets, including cash, for it to be operating.

So that, for example, in the case of IBM, some of that $4 billion would be moved over into a new entity and although it would, in the long run, bring some additional earnings to that firm, it would mean

presumably that it would be getting increased competition from its entity and therefore it would be forced to give better service and lower prices and serve the consumer better.

Now, I might say that I'm not sure that this solution would be a good one in the computer industry because it implies that IBM could divide up into three pieces, one of which could be office products, and would still maintain its market share between those two. That would be quite difficult. It might work and it might not.

Mr. O'Leary. Thank you. I have no further questions.

Senator Hart. Mr. Granfield?

Mr. Granfield. Again, I will try to be brief, Mr. Chairman. In your prepared statement, and it's certainly not critical to your statement and your suggestions, you say "liberals and conservatives would tend to support their Government's wish and is the one most likely to bring the advantage of a free enterprise system in the computer market."

Do you have any evidence for that statement?

Mr. McGurk. No.

Mr. Granfield. Why did you make it?

Mr. McGurk. Because I talked to a number of economists, both liberal and conservative, and they seem to tend to be agreed on that. I take it you don't.

Mr. Granfield. Personally, I don't know what a liberal or a conservative economist is, either good or bad. It's like good or bad scientists. I don't know a good liberal physicist or a conservative physicist. You're either good or you're bad. Either your suggestions make sense and will promote consumer welfare or they won't.

I was just curious because, to my knowledge, I have read nothing in the literature which has given an indication, certainly of an empirical nature, that the Government's solution is the proper one in terms of proving the competitiveness of the computer market.

It may deal with another subject along that line. You have indicated that perhaps you will support the way the Government seeks to restructure the IBM Corp. and you communicate there might be some advantage to that.

Would you say they should prevent any computer company from being a total systems company? At least you might imply that the alleged market power of IBM is where it originates?

Mr. McGurk. The Government solution that I'm talking about is the one that was entered in the court as their relief plan, which describes the establishment of a number—the number was vague—of integrated systems companies that did the full range of systems. So am I afraid that seven companies with 10 percent and five more with 30 percent are going to dominate the market in some way? I don't understand how it would. Is that what you're asking?

Mr. Granfield. Maybe I don't understand. Is your solution different than the Government's?

Mr. McGurk. I think it's probably the best solution.

Mr. Granfield. And your caveat to that would be if any of these would grow in size they should be curtailed?

Mr. McGurk. I hope that they will. If any of them gets to the point where IBM is now they should be curtailed; yes.

If any of them gets so dominant that they can control the marketplace, yes; they should be curtailed. In probably the same way.

Mr. GRANFIELD. Well, as you may or may not know, it's my understanding that the structural approach implicit in S. 1167 says that even if we have four or five firms in the market, some are able to tacitly delude and act as if they're monopolists. Do you have any concern along those lines that you may replace one kind of monopoly with another, if indeed this could be interpreted as monopoly behavior?

Mr. McGURK. First, the solution the Government advances would leave at least 8 and probably more like 12 integrated systems companies, and I don't think anybody claims that there's like collusion with those numbers.

I'm not, frankly, as concerned with oligopoly collusion by silent agreements as some other people might be. I am mainly concerned with dominant market power, which I think is dangerous.

Collusion, if it becomes evident, can be handled by our current laws fairly well. People do go to jail.

Mr. GRANFIELD. So you're more concerned with the section 2 violations as opposed to section 1?

Mr. McGURK. Yes. I'm most concerned with the computer industry where it's clearly a section 2.

Mr. GRANFIELD. Clearly a section 2? I thought that had to be litigated.

Mr. McGURK. That's why it's litigation. It's very clear to me that it's fact.

Mr. GRANFIELD. What do you mean by market power; dominant market power?

Mr. McGURK. Well, I really can't add too much to the other testimony that's been given here in the last couple of days that describes it.

I described it or tried to describe it, at least from the viewpoint of a small competitor, in my paper. It means the ability to structure the environment in your way, and change that environment as you see fit; and I think you have heard testimony that describes how that has and can be done.

Mr. GRANFIELD. Wouldn't any technology leader in industry or low-cost producer have the ability to change the environment?

Mr. McGURK. In this industry that certainly has not taken place. That is to say that there has been a number of low-cost producers, those who have sold below the market price established by others.

In fact, I think it's the case that IBM is normally, if not always, the highest price in any particular area, so that most other people are selling at a lower cost.

There are some technological innovations that have been described that have been introduced and they have not changed the dominance of IBM nor the market environment.

Mr. GRANFIELD. Would you say that the automobile industry has recently been changed?

Mr. McGURK. I'm certainly not an expert on the automobile industry. Yes; the environment has changed in terms of the buying public's attitude. That's an important part of the environment and that certainly is the case; yes.

Mr. GRANFIELD. So we can't have change in the environment without having dominant market power?

Mr. McGURK. By environment I'm really looking at the kind of rules of the game. There are, in any business, some random factors that one

has to consider which includes the marketplace, the stock market in its up and going down, and whether we go to war or not the availability of money, whether or not your research team will hit on it or miss it.

Those are some random problems that you have. But those are common to all business. All business has the problem of operating in that kind of changing environment.

The difference is that in the computer industry there's a rather special set of rules that one has to understand and live by; and that isn't bad enough, but then they get changed, and not by the common factors. You have those, too, but by factors that tend to be, if you're very successful, you'll get whomped in some way or other.

Mr. GRANFIELD. Well, IBM didn't come to this market, or did they—this kind of market dominant power? It's my understanding Sperry Rand was, at least for a while, the leading firm.

Mr. McGURK. I'm sorry you weren't here, Mr. Granfield, when I covered that subject. That was never the case.

Mr. GRANFIELD. I was here for your whole testimony.

Mr. McGURK. I don't know when Sperry Rand was ever the dominant power except when they built the first computer. They bought a small company that had built a computer, was designing a computer, so in that sense, they had the first computer.

MIT had one before that, but by the time there was any significant activity, IBM, as was described earlier, linked it to their monopoly and punched cards, which they had, and which gave them the strength and muscle, market power, sales presence, image, and so forth, to just continue it right on.

Mr. GRANFIELD. Just one last question.

Mr. McGURK. Let me just add that I think Sperry Rand might have had the opportunity, but the oft-quoted statement that there's only room for 50 of these machines in the world was, I think, made by the market research department of Sperry Rand.

Mr. GRANFIELD. The way it could be proposed to restructure this industry, the feeling is apparently there's not that many internal economies of scale—at least they would be outweighed by the proposed restructuring. Do you know any evidence that would support that contention?

Mr. McGURK. No; nor any in the other direction. Data is very difficult to come by. I do believe that there's one area where there is real economy of scale—and that's a problem I frankly don't have a solution to—and that is in the development cost.

That is where there is obviously an economy of scale, particularly in software, because almost the entire cost of software is in its development.

The reproduction cost is almost negligible. It's equal to the postage cost, if you like, the shipping cost, and that definitely is a problem. There is considerable technical evidence to indicate that the amount and complexity of the systems software, which is the biggest part of that, is in the case of IBM software, larger than necessary, largely to make sure that the machines operate efficiently, as Mr. Sanders was saying.

I don't know whether that's the case or not. A lot of technical people believe that to be true. That's the only place where I feel that there is an economy of scale; and I don't know what that scale is.

I mean, in one sense it's infinite because the reproduction cost is zero.

Mr. GRANFIELD. But you would agree it's very difficult in terms of whether this restructuring will be to lower prices for computer uses. No one knows.

Mr. McGURK. Well, obviously no one knows the future. I think we can analyze the situation, and I think there have been some studies made that would tend to indicate that the cost of computing could come down significantly under greater competitive pressures.

Mr. GRANFIELD. What bothers me, Mr. McGurk, is that I often hear this argument, certainly implicit in the Industrial Reorganization Act, that more firms mean more competition, yet I know there is no evidence to demonstrate that.

I know that there's a competitive model and you get the competitive results. I know when there is a monopoly model, one firm in the industry. But there's a large area in between, all the way from two firms to several hundred firms.

I know of no evidence that tells me you're better off with three firms rather than having 10 firms versus three firms.

I don't deny that it's possible. I just don't know of any evidence. In restructuring IBM this way that's the road we are pursuing along, but I don't know any evidence that tells me that's a proper road to pursue. It seems to me it's fraught with tremendous risk.

Mr. McGURK. I submit that permitting IBM to continue their dominance of this very important industry, and possibly extend it in the way that Mr. Sanders has described, is much more dangerous.

Mr. GRANFIELD. I can understand why you feel that way. I'm just saying that to me the other path is fraught with even greater risk. Thank you very much.

Thank you, Mr. Chairman.

Senator HART. Thank you very much, Mr. McGurk. We are sorry we held you so long.

Mr. McGURK. Thank you, sir.

Senator HART. We have concluded the testimony scheduled to be received today. We will adjourn, to resume tomorrow morning at 10:30 a.m., in this room.

[Whereupon, at 5:10 p.m., the subcommittee adjourned, to reconvene at 10:30 a.m., Friday, July 26, 1974 in room 2228, Dirksen Senate Office Building.]

[The following was received for the record:]

MATERIAL RELATING TO THE TESTIMONY OF DAN L. McGURK

Exhibit 1.—*Prepared Statement of Mr. McGurk*

STATEMENT OF THE COMPUTER INDUSTRY ASSOCIATION, AS SUBMITTED BY DAN L. McGURK, PRESIDENT

HART SUBCOMMITTEE TESTIMONY

Gentlemen, I appreciate the opportunity to again appear before your Subcommittee, having previously testified in the opening hearings which you held on the Senate Bill S–1167 in May, 1973.

You have already heard testimony in this set of hearings that described the structure of the market place, and some of the problems for users and competitors alike that are created by the dominance of one firm in this important industry. I would like today to indicate from a more practical and parochial viewpoint

what the results of such market dominance are to a competitor in the industry. That is, what are the practical effects of the market power of the dominant firm. In addition, I would like to point out some of the problems inherent in our current legal system, indicate criteria necessary to solve this problem and make modest contribution to the task of devising more appropriate legislation.

There are two important constraints on the way in which a smaller competitor must operate in the data processing industry today. In the first place, he must adjust his total business strategy to take account of the fact that he must compete in an environment which has been structured by the dominance of IBM. This entails his acceptance of a set of conditions which he must operate if he is to have a successful business; in addition to that, however, a small competitor finds it necessary to make relatively rapid and sometimes major changes in his business strategy when IBM decides that the environment is due for a change. In other words, not only is the competitive environment a difficult one, but that environment is subject to "change without notice" when IBM's corporate objectives are not being met within that environment. This makes the business strategy of a smaller competitor extremely difficult.

The structure of the environment

As I am sure you have become aware during the course of these hearings, the computer industry is an extremely complex and diverse one. It has within it many small specialized submarkets as well as a very large total market place. The large market place is characterized by a very definite customer demand for *rental* rather than purchase of this important capital equipment. Although there are specialized market places where purchase is the more likely means of equipment acquisition—such as some research laboratories and specialized applications—the vast bulk of users are accustomed, by a long period of IBM market control, to leasing their equipment on a month-to-month basis. What this means for a small company attempting to grow is that it must defer profits into the far distant future and, perhaps more importantly, be able to acquire the relatively large financial resources necessary to design, develop, program, produce, market and deliver the product without any financial return until a significant period of time has passed. Since such a large store of capital is extremely difficult for a smaller company to acquire, considerable efforts have to be focused on identification of customers who are interested in purchasing rather than renting, and marketing effort must be devoted to demonstrating not only that the equipment and services are superior to alternate offerings, but that the form of acquisition should be either long-term leasing or purchase. That is to say, the sales job is a lot simpler if a supplier does not need to worry about whether the customer desires to rent on a short-term basis, contract for a longer term lease, or buy equipment outright. Thus a smaller competitor, without the large financial resources of IBM, must sell *more* than the superiority of his own equipment and services; he must also convince the customer to make a purchase commitment to which he is not accustomed. In addition, the top management of a small company must be spending a considerable proportion of its energies on solving the problem of raising capital rather than on just improving the operation of the business.

A second major environmental constraint to a small competitor in this industry has to do with the enormous "weight of software" which overhangs the market place. By avoiding significant software standardization, IBM makes sure that its enormous resources devoted to creating new software make it impossible for any competitor to compare with it in the amount of software available to customers. I remember particularly a point in time at Scientific Data Systems—a small general-purpose computer manufacturer—when we had been successfully in business for about five years, with annual revenues between $50 and $100 million. We were very proud of having accumulated about $30 million worth of software which we had written over the course of the company's history. It was then that we discovered that IBM had invested, in its 360 operating system alone, over one billion dollars worth of effort. Even assuming that we were twice as efficient in software creation (which we thought we were), that is an extremely high barrier to cross when convincing a customer that your offering is a viable alternative.

New firms in many industries are able to compete because of significant technological innovation, which creates a market for a newly designed product. Because of IBM's enormous market power, in the computer industry such innovation must be limited to doing just what IBM does in some better or new way.

A new "widget" to improve the data processing function cannot have a broad market acceptance until IBM legitimizes it by coming out with a comparable widget itself. Until that happens, any inventor of such a new widget has to have his marketing force spend most of its time explaining why the widget is good, why IBM doesn't have it, and whether or not it will make a system encompassing the widget non-compatible with "the standard of the industry," that is, IBM. This necessity to match IBM on a functional basis is one reason that there has developed an industry of "plug compatible" peripheral devices and, recently, even central processing units as well as software and recording media.

Another fact of life for a smaller competitor is that IBM, by its size, has the ability to, and in fact does, completely blanket the worldwide computer market place with its sales force. Not only does this mean that more opportunities are available to IBM, but it also means that many corporations with large offices or plants in smaller towns have a strong predisposition to go to IBM to make sure that if they adopt one manufacturer throughout their company they can be assured of sales and service at all their locations. In order to combat this problem, marketing strategies of small competitors must devise a way to focus their efforts by geographical area or industry application in order to be able to offer anything approaching such total coverage. This is another impediment that makes the business strategy of a smaller company extremely difficult.

The net result of the structure of the environment described here is that a small competitor has to locate either a market where IBM has not focused any attention (normally because it is too small to be of great interest) or to live within the environment structured by the dominant company. Most firms attempting to grow in the computer industry have started out with the first strategy, and then in order to expand their market have been forced to live with the difficult environment created for the computer industry by IBM.

Changing the Environment

Having developed a business strategy which permits existing and growing in the above-described environment, a smaller competitor has to accept the fact that the environment can be changed by the whim of IBM. It matters very little if that whim comes about because a company or some group of companies have become successful, and therefore deliberate action is taken to limit their growth, or whether some other cause creates a corporate need for IBM to change its practices in the market place. In either case, disaster can result; if a mouse has learned to live in a stall with an elephant, whether the elephant steps on the mouse intentionally or not, he can still be wiped out.

One of the solutions to the leasing problem devised in the late 1960's came about through the creation of a number of independent leasing companies that bought equipment from IBM or its competitors and released it to customers. Based on the historical relationships between IBM sales prices and rental prices, this appeared to be a relatively viable business. On the introduction of new machines, however, and after the leasing companies had begun to impact IBM's business plans, IBM drastically changed the relationship between purchase prices and rental prices, thus making the leasing industry relatively uneconomic. Shortly thereafter, IBM also introduced long-term leasing plans, which had previously been offered by their competitors. IBM was constrained by the Consent Decree of 1956 from offering such plans until 1966, and it was not until 1969 that such an offering was made. This had the result of creating a new opportunity for the leasing companies (since they could more easliy compete with this form of contract while at the same time destroying a small competitive advantage which their hardware competitors had been able to create, given the previous environment.

In fact, IBM long retained a price umbrella for all of their competitors, carrying out a policy of never reducing the prices of currently available products. Although this policy still appears to hold in theory, starting in 1969 and 1970, IBM introduced new products with new product numbers that turned out to be technically indistinguishable from older products except for the changed model number designation and a sharply lower price. This created considerable havoc in the plug-compatible industry which had grown up in the interim, as is evidenced by the material made public in the Telex vs. IBM case. And perhaps most difficult of all, IBM, having announced in 1964 a compatible set of systems which had common interfaces to peripheral units, has gradually been altering that customer oriented policy in order to prevent or make more difficult the interconnection of non-IBM peripherals to IBM central processing units.

One can go on: changing specifications for media, stopping support of previously supported software when a certain class of terminal becomes a problem; eliminating software interfaces in new software releases where competing software is competitive; however, it seems to me that this point is proven by the following incident. The Computer Industry Association identified a potential problem in the future of data security. It is clear that in the future it will be necessary and important to provide means for users to prevent unauthorized accessed to their data files in order to provide data privacy and confidentiality. The CIA has suggested that one dangerous possibility in that regard is the creation by IBM of a hardware/software privacy lock which prevents other manufacturers from providing access to or compatibility with IBM systems. We have announced this fear in many forums, including National Bureau of Standards seminars, National Computer Conference panels, etc. Although there may be argument with our fear and concept, there has been no comment *ever* made that IBM *could* not or *would* not embark on such a strategy to change the environment and prevent or reduce competition. In other words, industry leaders are so used to the dominance of IBM in creating and changing the environment in which they operate that they don't question that continued factor.

Can Our Current Laws Solve the Problem?

I would like now to turn to the question of whether or not our current laws and legal processes can solve the problem of IBM's monopoly power and dominance as outlined both in my paper and other evidence presented to your Subcommittee. A look at the history and status of the Government's antitrust action against IBM might be instructive in that regard.

A brief examination makes it clear that speed in such a solution is unlikely. The Justice Department has sued IBM for Sherman II violations in 1932, 1952, and 1969. The latest effort, five and one-half years old, is due to go to trial in four months, although many observers believe that that schedule will not be met. Even if it were to be met and IBM be held in violation of the Sherman Act, it would be many years—up to 15—before the solution which the Justice Department would like to impose has been developed, screened, analyzed, adjudicated, negotiated and implemented. At the very best, this means that a solution is created which solves a problem identified 10 to 20 years previously. In a high-technology, rapidly changing industry, this is obviously unacceptable. Justice delayed is justice denied, and justice delayed is, in this particular case, to be applied to a situation from ancient history. Given the legal resources of a large monopoly, the necessity to operate within our current laws, and with the safeguards of our current legal system, it appears that reasonable speed in the solution of a monopoly problem is not possible today.

The problem of a timely solution can be divided into two parts. The first of those is, "Is it possible within our current laws to establish a violation of the Sherman and/or Clayton Act on the part of a dominant company in a resonable period of time?" It is clear that one purpose of S-1167 is to solve that problem by establishing criteria more easily proven; I commend the concept, if not the specifics of that bill. The second problem is, "Given the finding of monopolization, is it possible within our current structure to establish and carry out a relief plan that will solve the problem?" From past history, one has to assume that the courts, upon prosecution by either the Federal Trade Commission or the Justice Department, have an automatic bias toward regulation. It seems quite straightforward and easy for a court to lay down a series of injunctions, either by court order or through a consent decree, which regulate specific practices or business conduct. From the few instances in which a solution has been found through restructuring or divestiture, we must assume that our current system is much less able to deal with any solution other than regulation.

Criteria for a Solution

In the particular case of the computer industry, what criteria must a solution meet? Rather than generalize, I will attempt to list specific criteria which must be satisfied for the problem of monopoly in this industry to be solved.

1. The first and most important criteria is that the solution should break the market power of the dominant company or control it in such a way that it is deleterious neither to computer users nor other competitors attempting to supply alternate products. This includes insurance that IBM or its remaining entities do not have the ability to create and change the environment in which competition takes place in the computer market place. To accomplish this, it would undoubtedly be necessary to eliminate or sterilize the four billion dollars in

cash assets that stand behind IBM's enormous financial power and market control. At the same time, the large accumulation of software cannot be permitted to continue IBM's lock on the market place.

2. Any solution would have to lead towards an interchangeability of competing systems. This implies a rigorous industry effort on standards and interchangeability in both software and hardware. Only if such compatibility were established would it be possible for competing entities to offer comparable products and services to all computer users.

3. Assuming that a solution did not create a large number of competing entities in place of IBM, it would be necessary that no company could dominate the injection of technology by surprise announcements of new interfaces between various pieces of hardware and between hardware and software. An analogy here could be made to the recent agreement between Bell & Howell Co. and Eastman Kodak on disclosure of related technological developments in the film industry in order for camera makers to be able to respond.

4. Next, any solution would have to encourage relatively easy entry for new firms into the market place. If we define a competitor as a firm that is one per cent of the size of IBM, there have been no new competitors in the computer industry for at least ten years.

5. The computer industry today contributes a significant dollar amount to our balance of trade. A solution must not change, and in fact should be designed to improve, the positive balance of trade created by the computer industry.

6. Perhaps most importantly, any solution should take advantage of the forces of free enterprise and managerial entrepreneurship which are available to this economy.

7. Lastly, a solution should be implemented this *century* if not this *decade.*

Dimensions of Possible Solutions

The boundaries within which a solution will be found are: a restructuring of IBM into several competitive entities, as requested by the Justice Department; regulation of IBM's business and business practices in a form comparable to the Consent Decree of 1956; and a whittling of IBM's market share through a combination of regulation and divestiture, looking forward to a time when more competitive conditions would exist in the industry, at which point the regulation could be removed. Numerous proposals have been made, in this forum and others, which fall within these boundaries. It is worth considering each of the three modes of extremity as a framework for evaluating proposals.

Regulation through court order, whether arrived at by a judgment or a consent decree, would lay down a set of rules under which IBM would have to conduct its business in the future. The rules devised would be intended to guide and control IBM's market practices and policies for the benefit of users, and to permit a viable competitive industry to develop and prosper. The rules would undoubtedly include some restraint on the permitted contractual forms for IBM to do business, perhaps, for example, prohibiting leases of a greater duration than one year. It would also include rules under which pricing could be set, and technological changes introduced. The regulation of such things as the transportation industry, the communications industry and public utilities would be a model for the type of regulatory activity which would result from this mode.

There is ample precedent for this kind of action in the United States economy. Where problems of natural monopoly, or unlimited economies of scale have arisen in the past, this solution has been used many times. It is certainly in keeping with the economic school represented by Professor Galbraith. On the other hand, most of the current trends within both the Executive and Legislative branches of the U.S. Government are directed away from such regulation; in fact, there are numerous efforts afoot today to de-regulate some of the regulated industries. In addition, most economic schools of thought, either liberal or conservative, tend to feel that the advantages of the American free-enterprise system are reduced insofar as such Government regulation is undertaken.

Certainly the current philosophy within the Antitrust Division of the Department of Justice is away from additional regulation of American industry. Despite industry's general interest in promoting competition and the lack of Government interference, most industries which have once embraced regulation by the Federal Government find the protective aspects attractive, partly because, as demonstrated in the Penn-Central fiasco, such regulation normally precludes bankrupcty.

The second node of possible solutions, here called whittling, is a combination of temporary regulatory provisions, combined with strictures requiring a reduction in market share to some predetermined level (such as 30% of all applicable

markets) or divorcement from activities such as terminals or software which may represent the largest future growth areas in the industry. The combination of these two look toward the time when the market-share goals have been reached and the regulations are then automatically removed.

Since this solution has the expectation of removing all regulations, either after a given period of time when the effects are expected to have been achieved, or when a specific event occurs, they are, to conventional economists, a more attractive than indefinite regulation. In addition, since it ensures an expanding market share for competing companies, this plan has considerable attractiveness to those companies currently attempting to capture an increased market share through the working of the free enterprise system.

On the other hand, the consent decrees won by the United States against IBM in 1936 and 1956 were of such a kind. Since they have been largely ineffective in achieving their objectives, there are many within the industry and within the Government who are not sanguine concerning the likely results of such a whittling action. In an industry as dynamic as data processing, it would require an inordinate degree of foresight to be confident that the expected results could be achieved.

This solution is clearly the most penalizing one to the corporate entity of IBM. If it is successful in achieving its objectives, the plan undeniably rewards success by ensuring that growth will be zero or negative in the future.

The restructuring solution currently advocated by the United States is intended to go to the heart of the market power of IBM, splitting it ino a number of competing entities. Since none of these entities would have the image, installed base, resources or monopoly position of IBM, the assumption is that they would vigorously compete with each other as well as with other firms in the industry, and thereby restore open competition without regulation.

This restructuring would make the objectionable market practices less likely, since their effectiveness depends upon the total market power of IBM. Without such power, the encouragement of renting, lack of information on interfaces, tie selling, refusal to deal and unilateral establishment of standards would be much more difficult, if not impossible, to carry out.

The Government expects that this solution will lower the cost of computing through price competition among the new firms. It expects that by removing the image and enormous lease base of IBM—that is, splitting it up into a number of pieces—the price differential between IBM products and those of other manufacturers would be substantially reduced. Any other structural factors which would tend to give the newly created companies a competitive advantage—like access to IBM's component division on an exclusive basis—would also be removed.

The disadvantage of this solution is that the increased competitive atmosphere within the market place, and the probable lowered cost to the user could put the survival and viability of other mainframe firms in serious question. By leaving the installed user base intact, even though split among several firms, and dedicated to what is now IBM equipmnet, additional market share for CDC, NCR, Honeywell, Univac and Burroughs would be almost as difficult to achieve as it is today. Other factors in the industry would, of course, have additional potential OEM opportunities and OEM competition from the new entities.

The intention of the Government proposal would be that the sum of the balance of payment positions for the new companies would be exactly identical to that of IBM currently, with the hope that increased competitive factors between these companies could increase the U.S. share of foreign markets.

Most traditional economists, whether liberal or conservative, would tend to support the Government's solution as the one most likely to bring the advantages of the free enterprise system to the computer market. A combination of enlightened self-interest and doubts concerning some of the projected results of such a restructuring causes many industry executives to prefer either of the other two nodes of the solution matrix to the restructuring one.

Some Suggestions

On the more general topic of your legislation, I would like to advance a few modest proposals which might be worth considering as commendable additions to Bill S–1167 or reworked into a new piece of legislation. My comments are focused towards attempting to have a solution to the concentration problem assisted rather than opposed by the considerable entrepreneurial resources available in our free-enterprise economy.

In the first place, any statute on the subject should establish very clear criteria of concentration and/or monopolization. Today it is almost impossible to get a clear statement of what constitutes a violation of Section II of the Sherman Act. Such a criteria could easily be based on market share. Without a market share of approximately 30%, held for a reasonable period of time in a relevant market place, there cannot be market power. At the same time, a market could have a "four-firm concentration ratio" of 100% with no firm having as much as 30% market share, which would indicate that the criteria is not overly restrictive. Thirty per cent, therefore, seems like a minimum number, although it could be increased to a somewhat larger share. And clearly, if it can be demonstrably proven that over 30% of a market is required to achieve economies of scale, than it could be permitted, assuming that there were firm provisions that protected the consumer in such an unusual case. The point is that the danger of monopoly is the holding of market power rather than something vague like "attempt to monopolize".

But would not such a stricture create a strong disincentive to management? Why strive and compete if there is a mandated ceiling beyond which an enterprise cannot grow in the market place? This is a serious and real problem. Monopoly or a significant power over the market place is the goal of all managers of free enterprises. However, when such a goal is achieved, at least partially, the entrepreneurial energy is diverted to maintaining and extending the monopoly and avoiding prosecution by the authorities rather than creating ways of increasing service to customers. As a consequence, an alternate course must be devised which permits the entrepreneur to continue to compete, and creates greater rather than less competition.

I would like to make an additional proposal in this regard, which should be analyzed and investigated as one possible solution to this problem. The concept is that a "restructuring tax credit" comparable to the investment tax credit be established. A publicly held company which divests of a subsidiary completely—setting up an independent company, transferring appropriate assets to that company, establishing an independent board of directors and distributing the shares to its stockholders—would be permitted to take a credit against income tax for the following ten years. The credit would be a percentage of the assets transferred to the new independent company. In other words, a successful entrepreneur who reached the ceiling of his allowable market shares could spin off a competitive entity and achieve not only new ownership in a new enterprise for his stockholders, but in addition receive credit in his future income taxes for the economically sound act which such divestiture would represent.

Obviously, economic studies have to be made of the cost of such a proposal, as well as the proper level of tax credit—2%, 5%, 7%, 10% or 50%. I would suggest that the cost of such a program could be covered by a graduated income tax for corporations which increased to something like 65% for all annual taxable income over $100 million. Obviously the exact percentages in dollar amounts for these proposals will need to be closely scrutinized, but the concept of taxing to a higher degree those large agglomerations of power about which social policy is properly concerned would pay for the deconcentration instituted as an entrepreneurial venture by business managers. There is an almost unlimited store of creative enterprise available within our economy. Let us structure an environment which harnesses that energy to achieve deconcentration by incentives rather than through the dead hand of regulation.

In summary, Gentlemen, we have a real problem in the computer industry. Our current laws appear incapable of solving the problem in terms of either defining it or creating a constructive solution. What we need is clearly a criteria for a solution, and more creative ways in which such solutions can be structured.

THE INDUSTRIAL REORGANIZATION ACT (S. 1167)

(The Computer Industry)

FRIDAY, JULY 26, 1974

U.S. Senate,
Subcommittee on Antitrust and Monopoly
of the Committee on the Judiciary,
Washington, D.C.

The subcommittee met, at 10:42 a.m. in room 2228, Dirksen Senate Office Building, Hon. Philip A. Hart (Chairman of the subcommittee) presiding.

Present: Senator Hart.

Staff present: Howard E. O'Leary, Jr., chief counsel; Bernard Nash, assistant counsel; Patricia Bario, editorial director; Janice Williams, chief clerk; Peter N. Chumbris, minority chief counsel; Charles E. Kern II, minority counsel; and Michael Cranfield, minority economist.

Senator Hart. The committee will be in order.

Our first witness today is Mr. Hugh P. Donaghue, assistant to the chairman of the board, Control Data Corp.

I apologize for having been delayed at the office.

You are welcome and you may proceed.

STATEMENT OF HUGH P. DONAGHUE, ASSISTANT TO THE CHAIRMAN OF THE BOARD, CONTROL DATA CORP., WASHINGTON, D.C.

Mr. Donaghue. Thank you, sir.

I am pleased to have this opportunity to appear before the committee to review for you the historical development of Control Data's antitrust lawsuit against the International Business Machines Corp.

But first, let me say a word about Control Data. Control Data Corp. is a major manufacturer of computers and related computer peripheral equipment not only for our own systems needs, but we also manufacture peripheral equipment for other computer manufacturers in the United States and abroad.

In 1973, our computer operations produced revenues of $948 million. Of this, $330 million was overseas business. We operate in 31 countries worldwide and employ nearly 35,000 people in our computer business.

The corporation was founded in 1957 by William C. Norris, our chairman of the board. The growth of Control Data since its formation in 1957 was the result of careful concentration in selected areas, particularly in scientific computing, and the avoidance of general competition with the very much larger companies in the industry; as they existed in those days.

The technological excellence of Control Data's equipment, coupled with a careful marketing effort, enabled the company to gain an initial foothold in the industry.

Our first product, the model 1604 computer, was a great success and IBM was startled to see us getting orders from the prestigious organizations that were its first users.

The 1604 was announced in 1957 and it gained virtually immediate acceptance. It offered more price/performance to the important scientific segment of the market than any other large computer.

Because that type of customer relied mostly on his own software it was necessary to offer only a minimum amount of software and professional service support with the computer.

IBM's bundled pricing policy where hardware and software were provided as a package, and which could be applied to all types of users, made it possible for Control Data to set a lower price and yet maintain a reasonable profit on the total 1604 system.

This was accomplished by including only a minimum of software and support since the scientific customer in those days didn't really need or want the extra software and support.

The wide acceptance of the 1604 started Control Data on its way to becoming a major computer company. It also started a chain of events within IBM that took quite a different direction. IBM's reaction at first appeared confused because there wasn't any legitimate way to compete with the 1604 without a major change in IBM's pricing policy.

But ultimately they reacted violently, principally by the announcement of new computer models that were only slightly modified versions of their existing model 7090 computer, and with prices well below the 1604.

For almost a year after the announcement of the first modified version of the 7090 in 1961, Control Data was unable to get an order.

Finally we succeeded in getting some more orders by lowering our price and increasing the performance of the computer.

Also, we hastened to bring out a new computer, the model 3600. Each time that Control Data offered improved price/performance IBM countered by the announcement of further reduction in prices of slightly modified existing products or new paper machines.

In addition, buy-back arrangements, large educational discounts, and/or excessive free analyst support was provided for those users with less experienced staffs.

Our 3600 was followed by announcement of our 6600; and again IBM countered in the same manner and the struggle was prolonged for more than 10 years.

In my prepared statement I have detailed the various offerings that Control Data made and the countermoves that IBM made.

I would recommend that the staff read those actual details.

Senator HART. The statement will be printed in the record.

[Mr. Donaghue's prepared statement appears as exhibit 1 at the end of his oral testimony.]

Mr. DONAGHUE. Fine.

Late in 1964, because of IBM's actions, Control Data found itself in extremely serious circumstances.

It had not fully recovered from the devastating blow to our 1604. Also, other machines, the 1604A and the 3600 never gained very profitable positions because of IBM's continuing announcements.

Control Data had been making a number of proposals to the Bettis and KAPL Laboratories of the AEC for our 6600 computers.

Our first proposal was made in April 1964. Shortly after the submission of the first proposal we were notified that contracts were going to be negotiated.

Just prior to the beginning of those negotiations rumor had it that IBM had resubmitted their proposal and was offering a computer four times the capability of the 6600 at a substantially lower price.

Soon official notification was made to CDC that both laboratories had selected another manufacturer.

Six months later we learned that negotiations with IBM had not been concluded, and we were invited back for further negotiations.

Ultimately, Control Data received the contracts; however, only after price concessions of over $6 million and costly concessions on performance improvement and guarantees.

The temporary loss of the Bettis and KAPL contracts, and the aggressive selling of large paper machines by IBM, again brought Control Data orders to a virtual standstill for many months.

We don't have full information on the number of the 360–90 series computers that IBM produced. This was the computer series that was in competition with our 6600 at that point in time.

However, we do know that this number was very limited and, in fact, we believe certain models were never produced at all.

Moreover, we also know that they suffered huge losses on the development and manufacture of these models; losses far greater than any corporation would normally be willing to accept unless the purpose was to submerge competition.

By 1964 it was apparent that unless the U.S. Government again would bring antitrust action against IBM we would have to resort to legal action ourselves, and we began to build up a file of evidence of unfair practices.

Early in 1965 we requested the Oppenheimer Law Firm in St. Paul to analyze the situation in the light of the antitrust laws and to prepare a presentation for Control Data's board of directors.

On July 15, 1965, a presentation was made to the Control Data board and the Oppenheimer firm was authorized to begin to collect evidence from Control Data's marketing staff on IBM's marketing practices, which, when taken together with its market share should spell out a violation of the antitrust laws.

The results of this investigation were submitted to the Antitrust Division of the U.S. Justice Department as grounds for a Government investigation of IBM which might lead to a suit by the Government against IBM.

It was further planned that such legal efforts could serve the additional purpose of providing the foundation for a suit by Control Data in the event the U.S. Government failed to act.

Starting in January of 1966 Control Data submitted a number of written memorandums to the Antitrust Division and had numerous conferences in Washington in an effort to point out the need for immediate governmental action against IBM.

I submit for the record memorandums submitted to the Justice Department in January of 1966.

[See exhibit 6.]

Mr. DONAGHUE. This document describes in detail the abuses that had occurred up until that time. The Justice Department exhibited some enthusiasm for Government action.

The chief of the Antitrust Division, however, told us in October of 1966 that the chances of the Government taking action before April 1, 1968, were very slight.

Now this particular data was important to Control Data, since it was possible that statutes of limitations might expire on certain allegations concerning IBM's practices, vis-a-vis our 1604 computer.

Our collection of data on unfair marketing practices continued through 1967 and into 1968. In the fall of 1968 it was the considered judgment of Control Data's management that the Department of Justice was not going to take any action against IBM.

Indeed, in early 1968—December of 1968—our legal counsel visited the Department of Justice and was informed that no legal action was contemplated.

Therefore, on December 11, 1968, Control Data filed suit in the U.S. district court in Minnesota. I have a copy of that complaint, sir, which I will also submit for inclusion in the record.

[The document referred to appears as exhibit 2 at the end of Mr. Donaghue's oral testimony.]

Mr. DONAGHUE. The corporation undertook this action with full realization of the magnitude of the task that lay ahead. Preparation and aggressive pursuit of the lawsuit against IBM would obviously require an enormous effort extending over many years.

This wouldn't be an ordinary lawsuit. It would be technically complex and there would be an enormous number of documents involved.

IBM's defense would be massive and shrewd. Many of our employees, particularly those in the upper echelon of management, would be required to assist the lawyers as well as participate as witnesses at the trial.

Nevertheless, the management of Control Data felt that the lawsuit was necessary for our survival.

The task was indeed enormous. A paralegal staff of approximately 120 people were engaged in the discovery process, in screening between 25 and 40 million documents in various IBM files throughout the country.

Of these, more than 1 million documents were copied on microfilm as being relevant to our allegations. An automated data base was established and software developed for an information retrieval system to provide access to relevant documents.

Of the 1 million documents that were copied onto microfilm, between 80,000 and 100,000 were put into the automated data base.

This required extensive coding, key punching, verifying, and so forth. We employed over 10 full-time lawyers on the case and had an additional 20 lawyers available on a part-time basis.

It is our understanding that IBM employed about five times as many.

For their part, we estimate that IBM reviewed over 120 million documents of Control Data's and they copied over 6 million of these

as being relevant to either their defense or to a counterclaim that they had filed against Control Data.

Up until the time of settlement in January 1973 our lawyers had taken over 100 depositions from individuals throughout the United States, and at the time of settlement the bulk of our effort had not really begun.

As I stated we did settle our case with IBM in January 1973. The settlement called for the transfer to Control Data of their Service Bureau Corp. subsidiary, and the payment to Control Data of $101 million.

Out of the $101 million, $15 million was for the settlement of Control Data's costs incurred in the preparation of the lawsuit.

It is impossible to estimate what the total costs would have been if we had proceeded to trial. But when you consider the additional effort involved in the construction of the case and the fact that we intended to use our computer data base with direct access by terminal during the trial, the costs involved would have been very large.

Now, sir, I would like to address the issue of structural relief. As Control Data's lawsuit proceeded the corporation retained an economist to look into the question of structural relief for the industry with a view for increasing competition without a substantial cost to the economy as a whole.

In 1970 a document was produced by this consultant entitled, "Achieving Effective Competition in the Computer Industry."

I have a copy of this document and would be pleased to submit it for the record, if you so desire.

[The document referred to appears as exhibit 3 at the end of Mr. Donaghue's testimony.]

Mr. DONAGHUE. On September 1, 1970, a copy of this document was submitted to the Department of Justice.

The divestiture measures in this plan are quite extensive and involve the formation of five computer systems companies, a Federal systems company, a terminal company, a components company, and a service company engaged in leasing, maintenance, and support of out-of-production systems.

In addition, four vertical divestitures breaking off the Service Bureau Corp. which Control Data has since acquired as part of our settlement with IBM, the Office Products Division, Science Research Associates, and World Trade Corp.

With respect to the five computer companies, it was realized that this would require some plant splitting. Specifically, the engineering function and some manufacturing lines would have to be transferred.

In addition, the software functions would have to be distributed. The plan does not envision giving each company a full line of peripheral products.

Forming the entities contemplated in the 1970 plan in such a fashion as to achieve a healthy balance appears to be the most serious defect of this plan.

The plan presumes that all overseas operations would be consolidated in the World Trade Corp. This results in World Trade Corp. being the largest entity, with nearly a full range of products and full integration from components to final device.

The product line would extend from System 3 to 370–155. And this was at that point in time in 1970. The power of the World Trade Corp.

is certainly great enough under the approach of this plan to dominate the other entities.

Unless the court could prevent the World Trade Corp. from competing in the U.S. market, it appears the World Trade Corp. would repeat history by ultimately dominating the industry.

At the other end of the spectrum there were companies which would have the System 3 product line with low profit margins and high marketing costs.

The service company, holding the out-of-production leases, would be faced with intense competition from the five computer companies with each trying to churn the lease base to get their equipment installed.

This suggests that there could be substantial deterioration in the rental and purchase prices of older equipment.

The practicality of establishing a terminal company in the 1970 plan also rests upon the extent to which the other companies are divorced from the terminal business.

The plan does not specifically address this issue. Assuming there are no restrictions on the other companies, it appears that the terminal operation might not survive except as a supplier of a limited variety of volume produced devices.

What I am trying to point out here is that we looked at this total divestiture plan, and no matter which way one tried to cut or slice the company up, it became a very difficult problem.

The problem was trying to keep some company—some part of that organization—from substantially dominating the industry and yet preventing the companies that were carved up from disappearing from the scene because of the way they were split.

So, in reflecting on this plan, members of Control Data's management were concerned about the risk of adversely affecting the U.S. position of dominance in the world market, and also minimizing the possibility of turmoil that some think would result from the dismemberment of IBM into sufficiently small entities to dissipate IBM's market power.

Therefore, a second plan was developed suggesting relief measures that would lessen IBM's monopoly power in the general computer market by a combination of structural relief and injunctions prohibiting IBM's monopolistic practices in that market.

Additionally, the suggested measures would immediately insulate, and therefore avoid, IBM's potential dominance of the related markets of data services, professional services, and remote terminals.

This relief proposal differs substantially in that it is not directed specifically to restructuring the computer systems business.

The approach recognized practical problems with restructuring the computer systems operations and instead looks to containment to prevent the spread of IBM's monopoly power into related growth industries.

Here structural relief involves limited divestiture and divorcement of related activities. Specifically, the plan calls for the divestiture of the components division, as had been mentioned in some earlier testimony, the service bureau, which they have divested, and the office products division.

The plan would divorce IBM from the remote terminals area, data communications, professional services, and educational services business.

The plan calls for injunctive prohibitions against essentially the same practices provided for in the Department of Justice memorandum.

I also have a copy of this relief plan and I would also be pleased to submit it for the record.

[See exhibit 4.]

Mr. Donaghue. This plan is intended to recognize the distinct and yet interrelated character of the many markets or subindustries that comprise the electronic data processing sector of the economy.

It is important to recognize that the effectiveness of the proposed relief is dependent upon the implementation of the entire group of measures because of their interrelationships.

The suggested measures in detail, then, are:

Divestiture of IBM's Components Division and prohibition of IBM from reentering the business of manufacturing semiconductors and other components.

Divorcement of IBM from the business of manufacturing and marketing remote terminals and communications-oriented equipment, including data base preparation equipment applicable to remote terminals.

Divestiture of the service bureau and divorcement of IBM from data services and time-sharing businesses.

Divorcement of IBM from the business of providing professional services, and education or training—other than providing those services associated directly with its computer sales—and divestiture of Sciences Research Associates.

Divestiture of IBM's Office Products Division and divorcement of IBM from the type of business conducted by that division.

Mandatory use by IBM of higher order languages, and mandatory disclosure of product specifications and design technology leading to hardware and software compatibility.

Prohibitions against unfair and predatory pricing practices, including, (*a*) bundling, (*b*) hidden discounts, (*c*) discriminatory pricing, and (*d*) fighting machines.

Prohibtion against marketing "paper" machines.

These measures of structural and injunctive relief must be coupled with a suitable means of policing. To enhance its effectiveness, the court decree should contain provisions permitting IBM competitors and customers to bring enforcement actions.

IBM's persisting market dominance is founded in its monopolistic share of the general purpose computer market, certain IBM-induced structural characteristics of the computer business that particularly entrench and magnify a dominant market share, and IBM's exploitation of certain unfair marketing practices.

IBM has created and buttressed its power with a set of "technological and market tie-ins" which enhances its ability to structure in ways to insulate its market position from competition.

In addition, IBM threatens to extend its domination of the computer market to the related markets of data services, professional services, education, and remote terminals—all markets suited to effective competition among smaller companies.

In summary, I consider that the decision to bring suit against IBM was extremely courageous on the part of Control Data's management.

However, if the Government had pursued its suit against IBM

earlier we would not have taken this step. In retrospect this was also a very sound step from the business viewpoint.

In addition, the settlement also involved a sound business decision.

In fact, Mr. Norris, our chairman and chief executive officer, has called this "the best business decision" he had ever made.

Senator HART. Thank you very much. I'm really not sure what conclusion to draw from the chronology, and I'm satisfied that varying conclusions, depending upon who looks at it will be drawn. But from your testimony it would appear that in January of 1966 Control Data went to the Department of Justice; that in December of that same year Control Data filed its action.

The Department, just about 3 years after Control Data, went to file its action, and trial is expected to begin this year.

That would be close to 9 years after filing the complaint. Is my chronology correct?

Mr. DONAGHUE. Mostly Senator, except on one point. We did file a memorandum with the Government in 1966. We did not file our complaint until December of 1968.

Senator HART. 1968?

Mr. DONAGHUE. Yes. Through 1967 and 1968 we were compiling evidence, and we went to the Justice Department in December of 1968 and asked were they going to do anything; and the answer was that no action was contemplated, so on the 11th of December we filed.

Then, on the last day of the Johnson administration they filed. So they actually did file 1 month after us, but 1 month before, for some reason, they contemplated no action.

Senator HART. I think Mr. Chumbris had a comment.

Mr. CHUMBRIS. Thank you very much, Mr. Chairman.

Mr. Donaghue, first we thank you for coming. Unfortunately, Mr. Donaghue, we didn't get your statement until about 5 p.m. last night and it's regrettable.

I only bring this up because we have had this problem before. I'm only saying it for the record so that people who come before the subcommittee in the future will bear in mind that you and many other businessmen have a particular problem. You want to present it to the subcommittee in your best light, but when we don't get a statement until the end of a long day of hearings, we have to take the statements of all the witnesses who are going to testify and then spend the rest of the night analyzing those statements. It really isn't conducive to the best type of a legislative hearing.

That's why we have the rule that statements should be submitted 72 hours in advance, so that staff can go over them, the Senators can go over them, and then they will be able to engage in colloquies with the witnesses for a more complete record.

The significant point is that some of the material that's in your statement and the two statements that are to follow are basic but controversial. If we had those statements last week then we would have been able to engage in colloquies with the prior witnesses on those issues for a more complete record.

I think it makes the plea that you were trying to stress before the subcommittee more difficult, because we don't get a complete record.

Now, I mentioned earlier during the hearings, that Mr. Hellerman, who was handling computer industries issues, and I took the trouble

to go to California to visit plants and attended a 3-day conference of the computer industry about 18 months ago so we could learn how computers were made and learn of the problems facing the industry. That was fine, but we have not been able to get the details that you were to bring out in your paper and the papers of two economists. We're learning some of the details for the first time. This is the first hearing I can remember in 17 years, Mr. Chairman, with the importance of this particular issue before us, that not one, including IBM, not one of the companies which are concerned about this particular problem bothered to send us the background material of what the key issues were going to be during the course of these hearings.

Now, with General Motors, A.T. & T. and with the oil industry hearings coming up we have had plenty of opportunity either to go to them or they come to us to give us this basic data.

It seems to me it places this subcommittee and some of the Senators at a disadvantage in trying to get to the key issues.

Now, I will say that Jack Pierce, on behalf of the Computer Industry Association, 2 or 3 months ago, did furnish some background which has been helpful. And Mr. McGurk and Mr. Biddle, when we were in California 18 months ago, were very courteous and helpful in arranging tours of some of the plants we visited.

I bring this up because this is a very significant hearing. It's a tough issue that the subcommittee is going to have to wrestle with. But if we don't have the information ahead of time we are not going to be able to get, at least in this first round, as good a record as we have developed in the other hearings—that we held and we are going to hold.

If it sounds like I'm chastising the people who are appearing before us, I'm sorry. But it's for the benefit of the witnesses and the people who are interested in a legislative purpose to be able to present the statements in plenty of time.

I'm sorry, Mr. Chairman, but I had to say this.

Senator HART. Let me, without softening the message, explain to the witness that it's a perfectly valid comment, but it's not aimed at him.

It is a problem this subcommittee has long wrestled with. Mr. Chumbris is right. The staff is much better able to develop the kind of record that all of us try to have if the testimony is available to them under the rules of 72 hours in advance.

It's altogether possible that there are some witnesses who are sensitive about appearances, who would think it wrong to talk to the staff 3 months ahead of time and some inquiring reporter could make that a very ominous and questionable piece of conduct.

The truth is it would not be fair but I suspect that there are some who think the better course of wisdom is to stay away from us.

Mr. DONAGHUE. Senator, I have no hesitation at all of visiting with the staff. As a matter of fact I have done this with some of the staff members in the past.

It was my impression in submitting this information this morning that this is the beginning of a dialog and I was giving you a viewpoint here.

I would like to say here and now that I'd be glad to come back any time, either informally or formally, and respond to whatever questions you may have about my testimony or with respect to all the documentation that is here.

I thought we were just opening up the discussion and that this round of hearings was the first round and that we would be called back, because it is a deep and complex subject that you've heard this week. There are many different views on structural relief, many differing views on whether you should or should not do anything with IBM or the industry. So, I'd say I'm available at any time.

Senator HART. Well, I don't know how many people do read the record but the 72-hour rule should be observed.

Mr. O'Leary?

Mr. O'LEARY. Mr. Donaghue, why did you settle?

Mr. DONAGHUE. I think I mentioned, Mr. O'Leary, that that was a business decision made on the part of Control Data, and the reasons are many.

One, the Justice Department had the suit underway. If you recall my statement that if Justice had started the suit earlier we would not have gotten involved.

Two, our suit was using a great deal of time on the part of Control Data versus management and the costs were extremely high.

Three, we felt that the offer for settlement on the part of IBM was reasonable.

Mr. O'LEARY. Was destruction of the data retrieval system a condition of the settlement?

Mr. DONAGHUE. My understanding is that the destruction of the index was a condition of settlement.

Mr. O'LEARY. With respect to the question of relief, I note that both of the plans call for a divestiture of IBM's component production facilities.

I take it you believe that that is feasible and would not retard the advance of technology?

Mr. DONAGHUE. I do.

Mr. O'LEARY. Second, I take it you also believe that any relief plan has to come to grips with IBM World Trade. If relief just applies to IBM's domestic facilities, is it your view that World Trade would enter the U.S. market and dominate it?

Mr. DONAGHUE. I don't see any way we could really stop them. If you break the others up into sufficiently small entities to dissipate their market power in the United States, the World Trade Corp. is a single entity, and as you probably realize, it has become two distinct entities in recent months, but nevertheless, its manufacturing capability, research and development capability, and marketing capability would certainly make it still the most powerful computer company in the world by a factor of two to three, if not four to five.

And I might also add, as far as computer systems growth is concerned, IBM World Trade Corp. is in the fastest growing part of the foreign marketplace.

Mr. O'LEARY. From the point of view of one with experience in the industry, would it make sense to link some of IBM's domestic assets to portions of World Trade assets, if you contemplate some horizontal divestiture?

Mr. DONAGHUE. We examined that problem and gave a lot of thought to how it could be accomplished, and came to the conclusion we just didn't know how to do it.

There are varying reasons for this. In the first plan that we developed on the horizontal divestiture we knew a fair amount about their plant structure and what was being built in the various plants here in the United States.

We didn't have that kind of information readily at hand for Western Europe and the Far East, so it wasn't as readily apparent to us just how you could go about this.

I'm not saying it is impossible. I'm just saying that when we examined it for the 1970 plan we just didn't know how to do it.

Mr. O'Leary. We have received testimony with respect to the different functions which may or may not be included under one roof.

We earlier received testimony that the CPU and systems software should be left under one roof, with respect to any reorganization which is contemplated. What is your reaction to that?

Mr. Donaghue. There are certain kinds of software that are so closely tied to the computer itself—that is the basic operating software—that the hardware and the software are usually developed along in parallel. As a matter of fact, in many instances of computer design that I can recall, one has influenced the other; the design of software has influenced the design of hardware and vice versa, and, therefore, I think that there are certain elements of software that must stay with the CPU.

Mr. O'Leary. With respect to your 1970 plan, did that contemplate that each of the computer companies would be capable of providing both systems and applications software?

Mr. Donaghue. Yes; it did.

Mr. O'Leary. The second relief proposal contains a mixture of divestiture and divorcement, with respect to the divorcement measures suggested, how long was that divorcement intended to last?

Mr. Donaghue. Well, we didn't set an actual time limit because it would vary according to the type of business. Now, the divorcement wasn't forever and so it's not eternal divorcement from the marketplace.

First, we mentioned that if it was done it had to be policed, and that part of the policing action would determine the particular form of divorcement and the timing of its termination.

Mr. O'Leary. One of the measures listed involves mandatory use by IBM of high order languages and mandatory disclosure of products specifications and design technology leading to hardware and software compatibility.

Would you explain the significance of that provision?

Mr. Donaghue. Yes. I think some of the other people that have testified might have mentioned something about this. Let's take the software area first.

One of the most difficult problems for a customer who does have current IBM equipment and contemplates making a change to another vendor is that he is faced with the problem of his current software and his capability of being able to take that software, which is usually a huge investment, and transfer to some other manufacturer's.

The higher the level of product language that is used the easier it is to accomplish this. Therefore, if we all happen to be using a higher level language—Algo, Cobal, Fortran—the user has the oppor-

tunity to actually compare the new hardware system that he's buying and its performance and not have to worry so much about the fact that the software might not run in that machine, because indeed it should.

Mr. GRANFIELD. Mr. O'Leary, would you yield for a moment?

I just didn't understand that. Could you please go over that again?

Mr. DONAGHUE. Yes. Certainly.

I'm trying to rephrase it so it will come out better.

I was speaking, primarily, first of higher level languages and standards involved with higher level languages.

The concept of developing higher level languages in the first place, and of evolving standards in the industry, was to enable ready transferability of programs written in those higher level languages from one machine to another.

The higher the level language, following the set of standards developed by the industry, the easier it is to write a program in Fortran and have it run on a Control Data piece of equipment today and a Univac piece of equipment tomorrow.

The closer your language is to the assembly language of the machine, or the code of the machine, the more difficult this transferability is. So, what we are suggesting here is mandatory use of higher level languages will allow future users an opportunity to consider the hardware he wishes to purchase rather than consider the bulk of software written in lower level languages which dictate a certain progression in computer development, going from one model of an IBM machine to another model, for example.

The other one was in regard to product specifications and design technology. This is an area that I'm sure you've heard about from the Computer Industry Association. This involves specifications in input-output, interface specifications of all kinds; at the device level and at the channel level.

The problem that has been pointed out—I think Mr. Sanders also mentioned this yesterday—is that when you design a device for the marketplace and you see the biggest part of the marketplace belonging to IBM, you will design a device that's compatible with IBM's. Unless you know their design specifications, or unless they are designed to a standard—one of the two—then you're always behind and have to wait until their model is in the marketplace before you know what you should design. Product specifications, if made available to competition once they're announced, or once, as I've heard said, introduced to the Government, and then released to the public, tend to help a number of the small companies.

Mr. O'LEARY. Does the second relief proposal represent a backing away from the first, or a backing away from horizontal divestiture?

Mr. DONAGHUE. It does not preclude horizontal divestiture as suggested in the first one; but what we're concerned about, and have been in our company, is to prevent IBM from continuing its monopolistic position in the segment of the business that was dying out anyway and allowing them to move into new market areas and fully dominate them.

We're in a very volatile industry, as you well know. You've heard presentations on how rapidly the technology has changed over the last 20 years, but segments of the business are also changing.

The marketplace seems to be constantly changing. One part is growing faster than the other and what our concern is that maybe when and

if we ever achieve some type of relief for the industry, it might just be the type of relief that IBM would welcome, because there are faster growing segments of the industry that they'd prefer.

One that was mentioned yesterday was the telecommunications industry. Back in our 1972 relief plan we recognized that, too. So, we may not be backing away from the total—the horizontal—divestiture. We know that it presents a number of problems but we also have said that, in itself, will not suffice.

Mr. O'LEARY. My last question is what do you think is necessary as a minimum for effective relief?

Mr. DONAGHUE. I would have to say our No. 2 plan, or second plan, as a minimum.

Senator HART. Mr. Chumbris?

Mr. CHUMBRIS. We have no questions, Mr. Chairman.

Mr. GRANFIELD. I have just one.

Who is the economist that was your consultant on divestiture?

Mr. DONAGHUE. Joseph Peck.

Mr. GRANFIELD. Thank you.

Senator HART. Thank you very much, Mr. Donaghue.

[The following was received for the record:]

MATERIAL RELATING TO THE TESTIMONY OF HUGH P. DONAGHUE

Exhibit 1.—*Prepared Statement of Mr. Donaghue*

PREPARED STATEMENT OF HUGH P. DONAGHUE, ASSISTANT TO THE CHAIRMAN OF THE BOARD, CONTROL DATA CORP., WASHINGTON, D.C.

Mr. Chairman, I am Hugh P. Donaghue, Assistant to the Chairman of the Board of Control Data Corporation. I am pleased at the opportunity to appear before this Committee to review for you the historical development of Control Data's anti-trust lawsuit against the International Business Machines Corporation.

Control Data Corporation is a major manufacturer of computers and related computer peripheral equipment not for our own systems needs, but we also manufacture peripheral equipment for other computer manufacturers in the United States and abroad. In 1973, our computer operations produced revenues of $948 million. Of this, $330 million was overseas business. We operate in 31 countries worldwide and employ nearly 35,000 people in our computer business.

The corporation was founded in 1957 by William C. Norris, our Chairman of the Board. The growth of Control Data since it's formation in 1957 was the result of careful concentration in selected areas, particularly in scientific computing, and the avoidance of general competition with the very much larger companies in the industry. The technological excellence of Control Data's equipment, coupled with a careful marketing effort, enabled the company to gain an initial foothold in the industry.

Control Data's first product, the model 1604 computer, was a great success and IBM was startled to see us getting orders from the prestigious organizations that were its first users. The 1604 was announced in 1957 and it gained virtually immediate acceptance. It offered more price/performance to the important scientific segment of the market than any other large computer. Because that type of customer relied mostly on his own software, it was necessary to offer only a minimum amount of software and professional service support with the computer. IBM's bundled pricing policy where hardware and software were provided as a package, and which could be applied to all types of users, made it possible for Control Data to set a lower price and yet maintain a reasonable profit on the total 1604 system. This was accomplished by including only a minimum of software and support since the scientific customer didn't really need or want the extra software and support.

The wide acceptance of the 1604 started Control Data on its way to becoming a major computer company. It also started a chain of events within IBM that

took quite a different direction. IBM's reaction at first appeared confused because there wasn't any legitimate way to compete with the 1604 without a major change in IBM pricing policy. Ultimately they reacted violently, principally by the announcement of new computer models that were only slightly modified versions of their existing model 7090 computer and with prices well below the 1604. For almost a year after the announcement of the first modified version of the 7090 in 1961, Control Data was unable to get an order. Finally we succeeded in getting some more orders by lowering our price and increasing performance.

Also, we hastened to bring out a new computer, the model 3600. Each time that Control Data offered improved price/performance, IBM countered by announcement of further reductions in prices of slightly modified existing products or new "paper" machines. In addition, buy-back arrangements, large educational discounts, and/or excessive free analyst support was provided for those users with less experienced staffs. Our 3600 was followed by the 6600 and again IBM countered in the same manner and the struggle was prolonged for more than ten years.

A more detailed picture of various product announcements is interesting:

1957–58.—Philco had announced the model 2000 (first installation 1957), and Control Data the CDC 1604 (first installation January 1960), both of which were solid state computers (the first of such to be offered in the commercial marketplace). IBM then started to *talk* about a "solid state 709," which they said would be bigger and faster than the 709 "when delivered."

1958.—CDC obtained its fourth order for a CDC 1604 from Convair to be used in an Air Force installation. Convair's purchasing manager telephoned an IBM officer in New York just prior to awarding that order to CDC, and a Vice President of CDC heard him ask if IBM was going to bid a "solid state IBM 709," because the Air Force recently had decided it would only order solid state computers for the future. IBM declared it would not bid such a machine at that time. Convair awarded the order to us for a CDC 1604. About one month later IBM announced its IBM 7090, the long-awaited "solid state IBM 709," with performance that IBM said was equal to or greater than the CDC 1604, which was then the largest solid state computer being offered for commercial sale in the world.

1959.—IBM installed its first model 7090 in November 1959.

1960.—CDC delivered its first model 1604 in January 1960.

1961.—IBM undercut the price of its model 7090 by announcing two modified versions of it, called the 7040 (first installation 1962) and the 7044 (first installation 1962) to provide a wider range of performance. By the announcement of what we termed "fighting machines," IBM killed the CDC 1604 and almost knocked us out of the big computer market and out of business (we had a dry spell of many months where we received no new orders). CDC's only retaliatory capability came from announcing the larger, more efficient CDC 1604A (first installation 1963), which again was hopefully to be the largest and most powerful computer in the world.

1962.—IBM retaliated with the 7094, which was a field upgraded version of their 7090. CDC was forced to respond with the model 3600, which was an upgraded version of our 1604A. The CDC 3600 (first installation 1963) was more powerful than the IBM 7094.

1963.—IBM responded by announcing and starting deliveries of their model 7094–II, which was an upgraded version of the IBM 7094. IBM was bound and determined that CDC should not get ahead of IBM in producing the largest computer in the world.

Control Data announced its CDC 6600 early in 1963, and the first CDC 6600 was delivered in September 1964. Meanwhile, in 1963 IBM talked with a number of specific large scale computer customers, such as the Atomic Energy Commission's Livermore Laboratories concerning a whole new line of machines known by various model numbers in pre-announcement versions, said line of machines to include very large computers at the level of CDC's 6600 or higher.

1964.—April 7, 1964, IBM announced its new 360 series of computers (so-called third generation) and then announced that the new line lacked an extra large computer. However, by May 1964, IBM started making a series of proposals for giant computers to Livermore Laboratories and others, including the following:

Model number and date introduced

IBM 360/90, May 1964 (this machine was withdrawn in August 1965—15 months later).

IBM 360/92, August 1964.

IBM 360/94, November 1964.
IBM 360/91, January 1966.
IBM 360/91K, January 1966.
IBM 360/91L, January 1966.
IBM 360/95, August 1965.

The model IBM 360/92 was described by IBM as providing speeds of 3 million executions per second, making it comparable to the CDC 6600.

The model IBM 360/91 was formally announced on January 18, 1966, and the January 21, 1966, issue of the *Wall Street Journal*, in announcing that the model 91 series were the upper end of the System 360 family of computers, said that these announcements effectively "scorched" rumors that IBM would drop out of the super computer market. Certainly there could be no doubt that this was IBM's intent.

Late in 1964, because of the IBM actions, Control Data found itself in extremely serious circumstances. It had not fully recovered from the devastating blow to the 1604. Also the 1604A and the 3600 never gained very profitable positions because of IBM's continuing announcements. Control Data had been making a number of proposals to the Bettis and KAPL Laboratories of the AEC for 6600 computers. The date of the first proposal was April 1964. Shortly after the submission of the first proposal, we were notified that contracts were going to be negotiated. Just prior to the beginning of negotiations, the rumor had it that IBM had re-submitted their proposal and was offering a computer four times the capability of the 6600 at a substantially lower price. Soon officials notification was made to CDC that both laboratories had selected another manufacturer.

Six months later we learned that negotiations with IBM had not been concluded, and we were invited back for further negotiations. Ultimately, Control Data received the contracts; however, only after price concessions of over $6 million and costly concessions on performance improvement and guarantees. The temporary loss of the Bettis and KAPL contracts and the aggressive selling of large "paper" machines by IBM, again brought Control Data orders to a virtual standstill for many months.

We don't have full information on the number of 360/90 series computers that IBM produced. However, we do know that this number was very limited and, in fact, we believe certain models were never produced at all. Moreover, we also know that they suffered huge losses on the development and manufacture of these models—losses far greater than any corporation would normally be willing to accept unless the purpose was to submerge competition.

By 1964 it was apparent that unless the U.S. Government would again bring anti-trust action against IBM we would have to resort to legal action ourselves and we began to build up a file of evidence of unfair practices. Early in 1966 we requested the Oppenheimer law firm in St. Paul to analyze the situation in the light of the anti-trust laws and to prepare a presentation for Control Data's Board of Directors.

On July 15, 1965, a presentation was made to the Control Data Board and the Oppenheimer firm was authorized to begin to collect evidence from Control Data's marketing staff on IBM's marketing practices, which, when taken together with its market share, should spell out a violation of the anti-trust laws. The results of this investigation were to be submitted to the Anti-trust Division of the U.S. Justice Department as grounds for a government investigation of IBM which might lead to a suit by the government against IBM. It was further planned that such legal efforts could serve the additional purpose of providing the foundation for a suit by Control Data in the event the U.S. Government failed to act.

Starting in January 1966, Control Data submitted a number of written memoranda to the Anti-trust Division and had numerous conferences in Washington in an effort to point out the need for immediate governmental action against IBM. I have here, and will include for the record, a copy of a memorandum submitted to the Justice Department in January of 1966. This document describes in detail the abuses that had occurred up until that time. The Justice Department displayed considerable interest and even exhibited some enthusiasm for government action. The Chief of the Anti-trust Division, however, told us in October of 1966 that the chances of the government taking action before April 1, 1968, were very slight. This date was important to Control Data, since it was possible that statutes of limitations would expire on certain allegations concerning IBM's practices vis-a-vis CDC's 1604 computer.

Our collection of data on unfair marketing practices continued thru 1967 and into 1968. In the fall of 1968 it was the considered judgment of Control Data management that the Department of Justice was not going to take any action against IBM. Indeed, in early December 1968, our legal counsel visited the Department of Justice and was informed that no legal action was contemplated. Therefore, on December 11, 1968, Control Data filed suit in the United States District Court in Minnesota. I have a copy of that complaint for inclusion in the record if you so desire, Mr. Chairman.

The Corporation undertook this action with full realization of the magnitude of the task that lay ahead. Preparation and aggressive pursuit of the lawsuit against IBM would obviously require an enormous effort extending over many years. This wouldn't be an ordinary lawsuit. It would be technically complex and there would be an enormous number of documents involved. IBM's defense would be massive and shrewd. Many of our employees, particularly those in the upper echelon of management would be required to assist the lawyers as well as participate as witnesses at the trial. Nevertheless, the management of Control Data felt that the lawsuit was necessary for our survival.

The task was indeed enormous. A para-legal staff of approximately 120 people were engaged in the discovery process, in screening between 25–40 million documents in various IBM files throughout the country. Of those, more than one million documents were copied on microfilm as being relevant to our allegations. An automated data base was established and software developed for an information retrieval system to provide access to relevant documents. Of the one million documents that were copied into microfilm, between 80–100,000 of these were put into the automated data base. This also required extensive coding key punching, verifying, etc. We employed over 10 full time lawyers on the case and had 20 additional lawyers available on a part time basis. IBM employed about 5 times as many.

For their part, we estimate that IBM reviewed over 120 million documents of Control Data's and they copied over 6 million of these as being relevant to either their defense or to a counterclaim that they had filed against Control Data. Up until the time of settlement in January 1973, our lawyers had taken over 100 depositions from individuals throughout the United States and at the time of settlement, the bulk of this effort had not really begun.

As I stated we did settle our case with IBM in January 1973. The settlement called for the transfer to Control Data of their Service Bureau Corporation subsidiary, and the payment to Control Data of 101 million dollars. Out of the 101 million dollars, 15 million was for settlement of Control Data's costs incurred in the preparation of its lawsuit. It is impossible to estimate what the total costs would have been if we had proceed to trial. But, when you consider the additional effort involved in the construction of the case and the fact that we intended to use our computer data base with direct access by terminal during the actual trial, the costs involved would have been very large.

I would now like to address the issue of structural relief for the computer industry: given, the Government's successful conclusion of its anti-trust suit against IBM. As the Control Data lawsuit proceeded the Corporation retained an economist to look into the question of structural relief for the industry with a view towards increasing competition but without substantial cost to the economy as a whole. In 1970 a document was produced by this consultant entitled, "Achieving Effective Competition in the Computer Industry," and subtitled, "A Plan for Divestitute." I have a copy of this document and would be pleased to submit it for the record if you so desire. On September 1, 1970, a copy of this document was submitted to the Department of Justice.

The divestiture measures in this plan are quite extensive and involve the formation of five computer systems companies, a Federal Systems Company, a Terminal Company, a Components Company, and a Service Company engaged in leasing, maintenance and support of out-of-production systems. In addition, four "vertical" divestitures breaking off the Service Bureau Corporation, which Control Data has since acquired as part of our settlement with IBM, the Office Products Division, Science Research Associates, and World Trade Corporation.

With respect to the five computer companies, it was realized that this would require some plant splitting. Specifically, the engineering function and some manufacturing lines would have to be transferred. In addition, the software functions would have to be distributed. The plan does not envision giving each company a full line of peripherals.

Forming the entities contemplated in the 1970 plan in such a fashion as to achieve a healthy balance appears to be the most serious defect in this plan.

The plan presumes that all overseas operations would be consolidated in the World Trade Corporation. The results in World Trade Corporation being the largest entity with nearly a full range of products and full integration from components to final device. The product line would extend from System 3 to 370/155. The power of the World Trade Corporation is certainly great enough under the approach of this plan to dominate the other entities. Unless the court could prevent the World Trade Corporation from competing in the U.S. market, it appears the World Trade Corporation would repeat history by ultimately dominating the industry.

At the other end of the spectrum, there are companies which would have the System 3 product line with low profit margins and high marketing costs. The Service Company, holding the out-of-production leases, would be faced with intense competition from the five computer companies each trying to "churn the lease base" to get their equipment installed. This suggests that there could be substantial deterioration in the rental and purchase prices of older equipment.

The practically of establishing a Terminal Company, in the 1970 plan, also rests upon the extent to which the other companies are divorced from the terminal business. The plan does not specifically address this issue. Assuming there are no restrictions on the other companies, it appears that the terminal operation might not survive except as a supplier of a limited variety of volume produced devices.

In reflecting on this plan, members of Control Data's management were concerned about the risk of adversely affecting the U.S. position of dominance in the world market and minimizing the possibility of turmoil that some think would result from the dismemberment of IBM into sufficiently small entities to dissipate IBM's market power. Therefore, a second plan was developed suggesting relief measures that would lessen IBM's monopoly power in the general computer market by a combination of structural relief and injunctions prohibiting IBM's monopolistic practices in that market. Additional, the suggested measures would immediately insulate and therefore avoid IBM's potential dominance of the related markets of data services, professional services and remote terminals.

This relief proposal differs substantially in that it is not directed specifically to restructuring the computer systems business. The approach recognized practical problems with restructuring the computer systems operations and instead looks to containment to prevent the spread of IBM's monopoly power into related growth industries.

Here structural relief involves limited divestiture, and divorcement of related activities. Specifically, the plan calls for divestiture of the Components Division, the Service Bureau Corporation, and the Office Products Division. The plan would divorce IBM from the remote terminals, data communications, professional services, and educational services business. The plan calls for injunctive prohibitions against essentially the same practices provided for in the Department of Justice memorandum. I also have a copy of this relief plan which I would also be pleased to submit for the record.

This plan is intended to recognize the distinct and yet interrelated character of the many markets or sub-industries that comprise the electronic data processing sector of the economy. It is important to recognize that the effectiveness of the proposed relief is dependent upon the implementation of the entire group of measures because of their interrelationship.

The suggested measures are:

Divestiture of IBM's Components Division and prohibition of IBM from re-entering the business of manufacturing semiconductors or other components.

Divorcement of IBM from the business manufacturing and marketing remote terminals and communications-oriented equipment, including data preparation equipment applicable to remote terminals.

Divestiture of the Service Bureau Corporation (SBC) and divorcement of IBM from the data services and time-sharing businesses.

Divorcement of IBM from the business of providing professional services, and education/training (other than providing those services associated directly with its computer sales), and divestiture of Science Research Associates (SRA).

Divestiture of IBM's Office Products Division and divorcement of IBM from the type of business conducted by that Division.

Mandatory use by IBM of higher order languages, and mandatory disclosure of product specifications and design technology leading to hardware and software compatibility.

Prohibitions against unfair and predatory pricing practices, including (a) bundling, (b) hidden discounts, (c) discriminatory pricing, and (d) "fighting machines."

Prohibition against marketing "paper machines."

These measures of structural and injunctive relief must be coupled with a suitable means of policing. To enhance its effectiveness, the court decree should contain provisions permitting IBM competitors and customers to bring enforcement actions.

IBM's persisting market dominance is founded in its monopolistic share of the general purpose computer market, certain IBM-induced structural characteristics of the computer business that particularly entrench and magnify a dominant market share, and IBM's exploitation of certain unfair market practices. IBM has created and buttressed its power with a set of "technological and market tie-ins" which enhance its ability to structure the market in ways to insulate its market position from competition.

In addition, IBM threatens to extend its domination of the computer market to the related markets of data services, professional services, education and remote terminals—all markets suited to effective competition among smaller companies.

In summary, I consider that the decision to bring suit against IBM was extremely courageous on the part of Control Data's management. However, if the Government had pursued its suit against IBM earlier we would not have taken this step. In retrospect this was also a very sound step from the business viewpoint. In addition, the settlement also involved a sound business decision. In fact, Mr. Norris, our Chairman and Chief Executive Officer has called this "the best business decision" he had ever made.

Exhibit 2.—*Copy of Complaint,* Control Data Corp. *v.* IBM

IN THE DISTRICT COURT OF THE UNITED STATES FOR THE DISTRICT OF MINNESOTA, THIRD DIVISION

Civil Action No.:
Filed:

CONTROL DATA CORPORATION, PLAINTIFF,

vs.

INTERNATIONAL BUSINESS MACHINES CORPORATION, DEFENDANT.

COMPLAINT

Plaintiff, Control Data Corporation, brings this action against Defendant, International Business Machines Corporation, and complains and alleges as follows:

I. JURISDICTION AND VENUE

1. This complaint is filed and this action is instituted under Sections 4 and 16 of the Clayton Act (15 U.S.C. Sections 15 and 26), and pursuant to 28 U.S.C. Section 1337, in order to recover damages for past violations and to obtain injunctive relief against continuing violations of Section 2 of the Sherman Act (15 U.S.C. Section 2).

2. Defendant International Business Machines Corporation (hereinafter "Defendant IBM") maintains offices, transacts buisness and is found within the District of Minnesota.

II. PARTIES

3. Plaintiff is a corporation organized under the laws of the State of Delaware with its principal place of business and administrative headquarters in Bloomington, Minnesota. It is the assignee of and successor in interest to Control Data Corporation, a Minnesota corporation organized in 1957. Plaintiff is engaged in the development, design, manufacture and marketing of computers, related

peripheral equipment, supplies and services in competition with Defendant IBM. Plaintiff mantains manufacturing, research, and sales facilities throughout the United States and in a number of foreign countries.

4. Defendant IBM is a corporation organized under the laws of the State of New York and is engaged in the development, design, manufacture, and marketing of computers, related peripheral equipment, supplies and services. Defendant IBM maintains manufacturing and research facilities at numerous locations throughout the United States and abroad, and markets its products and related services from well over 1,000 offices located in the United States and in at least 105 foreign countries.

III. DEFINITIONS

5. As used in this Complaint, unless otherwise indicated or qualified:

(a) "Computer" means a general purpose stored program digital computer system which is an electronic device designed to solve many types of data processing or computational problems, the exact nature of which problems may have been unknown at the time of its design; in solving such problems, all quantities and variables of data are represented by alphameric characters which are expressed as discrete or discontinuous electrical impulses and transferred into and stored in the device together with one or more programs or sets of instructions, also represented by electrical impulses, which internally stored programs direct or cause the performance of sequences of arithmetic and logical operations with respect to the data as well as such internally stored programs. "Computer" includes input and output devices and their control units; storage, arithmetic, control and logical units; and associated basic software.

(b) "Peripheral equipment" means those units of a computer, as above defined, consisting of such equipment as input or output and external information storage devices.

(c) "Tabulating equipment" means machines and devices used for entering, converting, receiving, classifying, computing, and recording data by means of punched paper or tabulating cards. Tabulating machines and devices may be electrically connected to computers (in which case, they are included within the definitions of "computer" and "peripheral equipment"), or an interconnected group or grouping of such machines and devices may perform their task mechanically or electro-mechanically entirely independent of a computer, generally controlled by means of externally wired programs (in which event they are referred to as "tabulating systems").

(d) "Hardware" means the mechanical, magnetic, electrical and electronic devices and other tangible components of a computer, including peripheral equipment, as contrasted with software or programs.

(e) "Programs" or "software" are routines or sets of instructions which control the operation of the hardware. Programs or software can be of several types, including operating system programs, compiler and assembler programs, and applications programs. "Operating system programs" are programs controlling such elements of the fundamental operation of the computer as flow of jobs and data within the computer. "Compiler and assembler programs" are programs which translate higher level languages and special codes to a form acceptable to the computer. "Applications programs" are programs developed to perform certain predetermined computations for specific jobs or problems and usually function in conjunction with an underlying operating system program.

(f) "Compatibility" or "compatible" means that one model or class of computer will translate, execute and process instructions or data which another model or class of computer also translates, executes, and processes without significant conversion or modification of the instructions, data or either computer.

(g) "Computer markets" or "interstate and foreign computer markets" means each and every one of the three markets defined in Paragraph 17, and "submarkets" means each and every one of the submarkets within each of said three markets, as identified in Paragraph 18.

IV. TRADE AND COMMERCE

History of the industry

6. Defendant IBM has manufactured and marketed the vast majority of the world's computers. A large part of the computer industry built upon and is the successor to the tabulating system industry, having substantially displaced the tabulating system industry due to the far greater capabilities of computers.

Computers are capable of processing immense quantities of data and solving extremely complex problems at speeds measured in millionths and billionths of a second. By contrast, tabulating systems were suitable only for the relatively slow and routine tabulating of information, although tabulating equipment continues to be used both by itself and in conjunction with computers.

7. In 1952, Defendant IBM owned approximately 90 per cent of all tabulating systems in use in the United States. In that year, the United States of America filed a civil action alleging that Defendant IBM had violated and was in violation of Sections 1 and 2 of the Sherman Act in that it had monopolized, attempted to monopolize and was then monopolizing interstate and foreign trade and commerce in the tabulating industry and had entered into contracts, agreements and understandings in unreasonable restraint of interstate and foreign trade and commerce in tabulating equipment and tabulating cards.

8. This litigation culminated in 1956 with the entry of a Final Judgment by consent of the parties which Judgment included requirements, among others, that Defendant IBM offer customers an opportunity to purchase as well as lease tabulating systems and computers, cease engaging in the service bureau business except through a separate corporation (subsequently, its subsidiary, The Service Bureau Corporation), and grant nonexclusive licenses under its existing and future patents relating to computers and tabulating systems.

9. The first experimental electronic digital computer was conceived and constructed commencing in the late 1930's, and several early computers were built during World War II for defense applications. The first commercial computer was delivered in 1951, and by 1953 approximatey 50 small computers were installed in the United States, some of which had been installed by Defendant IBM. By the end of 1956, approximately 570 computers had been installed in the United States, having a cumulative value of about $340 million. The growth of the computer industry has been very rapid since that date, with over 37,000 computers installed in the United States at the end of 1967, plus approximately 17,000 additional computers manufactured by United States companies and installed in foreign countries as of that year end. The total purchase value of these United States and foreign installations was approximately $18 billion.

Growth of defendant IBM

10. Since delivery of its first commercially marketed computer in 1953, Defendant IBM has experienced imposing growth, due principally to the manufacture and marketing of computers. In 1967, Defendant IBM was the eighth largest industrial company in the United States in terms of revenues and the fifth largest in terms of profits. The total stock market value of Defendant IBM's common shares has recently approached $42 billion, the highest of any private corporation in the world. Such value exceeds the combined value of the shares of approximately two-thirds of the companies which comprise the Dow-Jones industrial average.

11. In 1955, gross revenue of Defendant IBM and its subsidiaries from all activities was $696,294,457. Five years later, in 1960, such revenue had almost tripled to $1,816,882,259. By 1967, revenues of IBM and its subsidiaries had again tripled to $5,345,290,993, representing an increase in revenue of $4,648,996,536 over the 1955 level or over 650 per cent. The 1967 revenues exceeded 1966 revenues by over $1 billion or slightly more than 25 per cent. Revenues for the first nine months of 1968 were $4,908,971,604, representing an increase over the comparable 1967 period of $1,159,385,281 or more than 31 per cent.

12. Net earnings after taxes of Defendant IBM and its subsidiaries amounted to $72,695,855 in 1955. In 1967, IBM's net earnings after taxes amounted to $651,499,558, representing an increase of $578,803,703, or almost 800 per cent over the 1955 level. The 1967 net earnings exceeded 1966 net earnings by $125,369,366 or almost 24 per cent, and net earnings for the first nine months of 1968 exceeded the comparable 1967 period by over 37 per cent, after giving effect to the 10 per cent income tax surcharge applicable to 1968.

13. In 1955, net return of Defendant IBM and its subsidiaries on gross revenue (net earnings after taxes as a per cent of gross revenue from sales, service and rentals) was approximately 10 per cent. In 1967, net return of Defendant IBM and its subsidiaries on gross revenue was approximately 12 per cent, reflecting an increase in said net return of almost one-fifth over the 1955 level.

14. In 1965, Defendant IBM spent $210,932,946 on research and development activities alone, an amount in excess of the value of computer shipments by any other manufacturer in that year. This was an increase of almost $90,000,000 over

the amount it spent in 1961. Defendant IBM has continued to spend in excess of 5 per cent of its total revenues annually for product research and development, expenditures substantially exceeding the dollar value of annual computer shipments which most other manufacturers individually have been able to achieve.

15. During 1967, sales, service and rentals by Defendant IBM and its subsidiaries of computers accounted for well over two-thirds of its gross revenues. Most revenues were derived from lease rather than sale of computers. Defendant IBM is the largest manufacturer-lessor of personal property in the world, with in excess of 80 per cent of its computers on lease the purchase value of which as of year end 1967 was approximately $11 billion.

16. Worldwide employment by Defendant IBM and its subsidiaries during 1967 grew by over 23,000 to more than 221,000. As of May 31, 1966, Defendant IBM and its subsidiaries employed approximately 55,000 salesmen, systems engineers and customer engineers throughout the world of which approximately 32,000 were employed by Defendant IBM in the United States, its territories and possessions. The number of such employees has increased substantially since that date.

Definition of markets

17. The parts of trade or commerce wherein Defendant IBM has committed the violations of law hereafter alleged consist of (i) the manufacture of computers by United States companies or other companies and the marketing or distribution of such computers in the United States by such companies, (ii) the manufacture of computers by United States companies or by foreign companies controlled by them and the marketing or distribution of such computers in foreign trade or commerce by such United States and foreign companies, and (iii) a combination of (i) and (ii), any one of which individually constitutes a part of trade or commerce among the several states or with foreign nations within the meaning of Section 2 of the Sherman Act.

18. Within each of said three markets exist several product submarkets, identifiable on the basis of unique or distinctive features or characteristics of the computers or unique requirements or preferences of the customers in such submarkets. Such submarkets may be delineated, for example, on the basis of (i) differing capacity and processing speed of the computers, as generally reflected in different sale and lease prices, (ii) differing application or mode of operation of the computers, as often reflected in the differing industry classification of the users of such computers, or (iii) combinations of (i) and (ii). Each submarket of each of the three markets identified in Paragraph 17 individually also constitutes a part of trade or commerce among the several states or with foreign nations within the meaning of Section 2 of the Sherman Act.

V. VIOLATIONS OF LAW

First count: Monopolization

19. For many years and to the present time, Defendant IBM, directly and through its subsidiaries, has possessed monopoly power in the interstate and foreign computer markets and submarkets, which power it has willfully acquired and maintained, and Defendant IBM has there monopolized and combined or conspired with its subsidiaries to monopolize said markets and submarkets in violation of Section 2 of the Sherman Act.

Second count: Attempt to monopolize

20. For many years and to the present time, Defendant IBM, directly and through its subsidiaries, with a dangerous probability and likelihood of succeeding, has engaged in overt acts and conduct with the specific intent to injure or destroy competition in and monopolize the interstate and foreign computer markets and submarkets, and Defendant IBM has thereby attempted to monopolize said markets and submarkets in violation of Section 2 of the Sherman Act.

Monopoly power in the computer markets and submarkets

21. Defendant IBM for many years has possessed, or has had a dangerous probability and likelihood of possessing, power to control prices or exclude competition with respect to the interstate and foreign computer markets and submarkets:

Market share of defendant IBM and relative sizes of competitors 1953 through 1962

(a) Defendant IBM's first commercially marketed computer was the model designated the 701, initially delivered in 1953. The only other significant com-

mercial manufacturer of computers at the time was Remington Rand, Inc., which had acquired two companies whose first deliveries of computers preceded delivery of the IBM 701 by more than two years. By the end of 1956, measured on the basis of total dollar purchase value of installed computers at that time ("cumulative dollar value"), Defendant IBM held over 70 per cent of the interstate and foreign computer markets, and, when measured in terms of total dollar purchase value of computers installed during that year ("incremental dollar value"), Defendant IBM held over 75 per cent of said markets. Through the remainder of the 1950's, Defendant IBM maintained and increased its share of the computer markets and, in the early 1960's, with the advent of so-called "second generation" transistorized computers, Defendant IBM continued to dominate and in fact further increased its percentage share. By 1962, whether measured in cumulative dollar values or incremental dollar values, Defendant IBM held shares of the interstate and foreign computer markets ranging between 77 per cent and 90 per cent.

(b) During the 1950's, several companies in addition to Defendant IBM and Remington Rand, Inc., developed and began to manufacture and market computers. Despite very rapid growth of the computer markets, however, and whether measured in terms of cumulative or incremental dollar values, throughout the period 1956 through 1962 none of the said companies obtained more than a 5 percent share of any interstate or foreign computer market and cumulatively all of these companies did not achieve more than a 15 percent share of any market and typically held well below this share. Similarly, during this period, installations by Remington Rand, Inc. declined to where, by 1962, they approximated 7 to 8 percent of said markets measured in cumulative dollar values and 3 to 4 percent measured in incremental dollar values.

Market share of defendant IBM and relative size of competitors—1962 to present

(c) During the period 1962 through 1965, several of the other computer manufacturers began to experience modest success in marketing computers; there were indications of a possible challenge to Defendant IBM's predominant position in the interstate and foreign computer markets. As a result of orders for computers received during 1962–1964, United States computer manufacturers competing with Defendant IBM together accounted for shares approximating 35 percent of the incremental dollar value of installations during 1964 and 1965 in said markets, although Defendant IBM's shares of said markets measured in cumulative dollar values at each year end remained well above 70 percent.

(d) On April 7, 1964, Defendant IBM announced and began to formally market its System/360 series of computers which it said represented the most important new product announcement in Defendant IBM's history. Defendant IBM stated that System/360 marked a new era in the development of computers. Esurient marketing by Defendant IBM of System/360 resulted in unprecedented customer orders and, as a corollary, with the installation of the new computers, brought about Defendant IBM's anticipated resurgence of market position. Of an estimated \$3.7 billion in computers installed worldwide by United States manufacturers during 1966, Defendant IBM installed approximately \$2.5 billion or 68 percent. During 1967, the estimated value of worldwide installations of computers by domestic manufacturers rose by almost \$2.2 billion over installations during 1966, to \$5.9 billion. Defendant IBM's installations rose by \$1.7 billion, to approximately \$4.2 billion during 1967, thus accounting for over 77 percent of the increased value of 1967 installations. Furthermore, Defendant IBM's installations during 1967 represented an increase over its installations in the preceding year of approximately 70 percent, substantially exceeding the growth rate for the other domestic computer manufacturers during 1967 which was about 40 percent. Accordingly, when measured by incremental dollar values, Defendant IBM's shares of the interstate and foreign computer markets increased from between 62 and 70 percent during 1966 to between 70 and 76 percent during 1967; moreover, Defendant IBM's computer installations during 1968 have continued at such high levels that its shares of said markets, whether measured in cumulative dollar values or incremental dollar values have and will substantially exceed its 1967 shares.

(e) Despite the continued extraordinary growth of the interstate and foreign computer markets, the small shares thereof held by Defendant IBM's competitors by 1967, individually or as a group, almost paralleled in size the shares held by the firms which were attempting to compete in 1962. Thus, in terms of incremental dollar values, the second largest domestic manufacturer's worldwide installations

of computers during 1967 amounted to about 5.9 per cent of the total worldwide installations by United States manufacturers, followed by the third largest, with about 5.6 per cent of the total. The next five firms each accounted for from 2 per cent to 4 per cent of the total and the remaining firms combined accounted for approximately 1.7 per cent of the total. In terms of cumulative dollar values, the second largest domestic manufacturer's worldwide installations of computers at the end of 1967 was estimated at approximately 7 per cent of the total installations. The next seven firms each accounted for from .7 per cent to 5.3 per cent of the total. All other firms combined accounted for approximately 1.5 per cent of the total.

(f) Relative to the value of computer installations by any of its competitors, installations by Defendant IBM are immense. During 1966, Defendant IBM's estimated incremental dollar value of worldwide computer installations exceeded its next largest domestic competitor by over $2.2 billion or 9 times, whereas during 1967, Defendant IBM exceeded its next largest competitor by over $3.8 billion, or over 12 times. Relative to the ninth largest domestic computer manufacturer, Defendant IBM's estimated incremental dollar value of such installations during 1967 was more than $4.1 billion larger, or 80-fold larger. In terms of cumulative dollar values, Defendant IBM's estimated $12.5 billion in worldwide installations at the end of 1967 exceeded its next largest domestic competitor by approximately $11.3 billion or 10 times. Relative to the ninth largest manufacturer, Defendant IBM's estimated cumulative dollar value of such installations at the end of 1967 was almost 100 times greater.

(g) Defendant IBM's shares of and relative size in the computer markets are closely reflected in its shares of and relative size in the computer submarkets. Given its dominant position in the computer markets, over the years Defendant IBM's shares of many computer submarkets have approached and even exceeded 90 per cent. While on occasion certain other companies, in spite of Defendant IBM's power and activities, have managed to obtain shares of certain submarkets somewhat larger than their shares of the computer markets, these rare successes have typically been destroyed or overwhelmed by Defendant IBM's overall power in other computer markets and submarkets, and Defendant IBM has emerged with shares of such submarkets equal to or exceeding its shares of the computer markets generally.

Barriers to effective entry into the computer markets and submarkets

(h) Over the years, a number of domestic companies attempting to complete with Defendant IBM have abandoned their efforts to manufacture and market computers. The few companies which have remained have been unable to penetrate Defendant IBM's dominance. This has been due to the structure of, and the existence of substantial barriers to effective entry into the computer markets and submarkets, which structure and barriers have been consciously nurtured, complemented and constructed by Defendant IBM. Thus, despite the fact that at the end of 1967 the cumulative dollar value of worldwide installations by United States manufacturers exceeded the value of installations one decade earlier by almost 3,000 per cent, and the incremental dollar value of such installations during 1967 exceeded the value of such installations during 1957 by over 2,200 per cent, the number of companies individually accounting for at least one-half per cent of either the cumulative or incremental dollar value of such installations had remained essentially constant at approximately 10. Moreover, aside from these, the incremental dollar value of worldwide computer installations during 1967 by all other domestic manufacturers combined accounted for significantly less than 1 per cent of the total.

(i) A significant deterrent to effective enery into the computer markets and submarkets is the potential entrants require massive aggregations of capital for research and development, to find computer leases, and to provide associated software and maintenance services.

(j) The vast quantity of computers which Defendant IBM has installed, as well as the extreme complexity of computers, gives Defendant IBM a substantial advantage over competitors or potential competitors in the sale or lease of computers in that:

(i) The number and variety of programs available for use on any manufacturer's computer, as well as personnel trained to write programs for, operate and maintain the computer, are all proportionate to the number of computers which that manufacturer has installed.

(ii) A substantial number of customer personnel engaged in use or procurement of computers were trained on Defendant IBM's computers or formerly

employed by Defendant IBM, and they thus are more familiar with and predisposed toward Defendant IBM's computers. Moreover, due to the complex nature of computers and, in general, the short supply of trained personnel, computer customers frequently are compelled to rely upon a computer manufacturer's representations and apparent reputation.

(iii) There is considerable customer resistance to change computer manufacturers. In addition to the cost of hardware, a customer spends substantial sums in training personnel to use the computer, in programming, and in preparing his data and his site for the computer, a large proportion of which expenditures may have to be duplicated if the customer replaces that computer with another manufacturer's computer.

Profits and pricing power

(k) A number of computer manufacturers have been forced to abandon the computer markets and submarkets due to inability to realize profits and, indeed, most companies which remain have absorbed significant losses. Defendant IBM, on the other hand, has continuously enjoyed substantial profits and a wide choice of profitable alternatives in the manufacture and marketing of its computers.

(l) Defendant IBM exercises price leadership in the computer industry, and, therefore, the sale and lease prices and other terms and conditions of computers manufactured and marketed by other companies must in large part be determined by them relative to prices, terms and conditions established by Defendant IBM. Moreover, Defendant IBM's pricing power is enhanced because over the years its product line has blanketed the industry, whereas the smaller companies have typically been forced to concentrate on the design, manufacture and marketing of more limited product lines.

22. The manufacture and marketing of computers is one of the most rapidly growing and important segments of the United States economy and contributes substantially to the technological leadership of the nation as well as its national defense. Despite the entry of a Final Judgment directed against Defendant IBM's power and activities in the tabulating systems industry, Defendant IBM built upon its power within that industry to achieve similar dominance in the computer markets and submarkets by the mid-1950's and has retained such power up to the present time.

Exclusionary practices

23. Defendant IBM, directly and through its subsidiaries, has wilfully acquired and maintained monopoly power in the computer markets and submarkets, or has had the specific intent to obtain such power, in that it has consciously, deliberately, or intentionally engaged in the following acts, behavior, conduct and practices, among others:

Development, delivery, and performance of hardware and software—"Paper machines and phantom computers"

(a) It has misrepresented the status of design, development, production, and performance of certain of its computers, and programs or software for certain computers, particularly with regard to the capabilities and availability of large size computers, time sharing computers, and compatibility between models of computers, all for the purpose or with the effect of depriving customers of the opportunity to accurately evaluate competitive computers, thus obtaining or retaining customers for itself and depriving Plaintiff and other manufacturers of sales;

(b) It has, as a means of obtaining or retaining customers and depriving Plaintiff and other manufacturers of sales, offered to lease, sell, or make delivery of, and has entered into agreements to lease, sell, or make delivery of computers, software or programs which were not yet in production, for which it was not ready to commence production, and as to which it had no reasonable basis for believing that production or delivery could be accomplished within the time periods specified by such offers or agreements;

(c) It has, having prematurely announced and marketed its computers to deprive its competitors of sales and due to computer development and production deficiencies arising from such prematurity, frequently changed and delayed its previously announced or promised delivery schedules as well as announced or introduced changes in, or cancellations of, certain types or models of computers, their specifications and alleged capabilities, thereby creating confusion in the market and, at great cost to its competitors and its customers, deferring procurements until its competitive deficiencies could be discovered or overcome and maximizing its revenues on outdated computers on lease;

(d) It has repeatedly entered into contracts, commitments, and letters of intent in which it was obligated to furnish computers and software and, having deprived its competitors of such sales, has then failed to fulfill the obligations undertaken in such contracts, commitments, and letters of intent;

(e) It has consistently induced customers, upon the execution of a contract with it, or even prior thereto, to expend substantial sums of money preparing data, training personnel, preparing a site for the computer, and preparing for the use of certain software or programs, all for the purpose or with the effect of irrevocably tying the customer to its computer irrespective of actual delivery or performance of the computer or software thereby precluding said customers from acquiring computers from Plaintiff and other manufacturers;

The actions of Defendant IBM alleged in the foregoing subparagraphs (a) through (e) were taken with knowledge of and to take advantage of its dominant position in the computer markets and submarkets. Because of the large dollar investment in computers, their complexity, the difficulties of verifying claimed specifications of undelivered products, and a history of rapid technological obsolescence of computers, customers in the computer markets and submarkets readily rely upon representations and promises of Defendant IBM. This is particularly true when the representations concern a new product line of computers allegedly meeting all needs of customers and compatible from smallest to largest.

Discriminatory and exclusionary pricing practices

(f) It has directly and indirectly offered discriminatory prices and discriminatory services and technical assistance to some customers not given to other customers, including, among others, outright discounts from standard published prices, free "trial" computer usage for extended periods of time, buybacks of computer time which it may or may not utilize, discounts in the form of fictitious "value received" contracts, extended purchase plans, and unusual and substantial commitments of free manpower for programing, maintenance and systems support. The recipients of such prejudicial favoritism are typically customers or members of a class of customers where:

(i) Defendant IBM's market share or power is less dominant or it is threatened by and encountering more intense competititon; or

(ii) Defendant IBBM stands to gain certain ancillary benefits or prestige in furtherance of its predominant position in the computer markets and submarkets;

(g) It has established sale and lease prices for some types or models of computers at levels which would result in a significantly lower percentage of return on gross receipts and investment than was realized from the prices established for other computers with respect to which it has a more dominant market position, or, with respect to which Plaintiff or other competitors have not threatened its market position, and it has used its profits or revenues from the sale or lease of some types or models of computers to subsidize its activities with respect to the marketing of types or models threatened by competition:

(h) It has sold or leased computers to cutomers located in some geographical areas at a lower rate of return on investment or sales than is realized in other geographical areas;

(i) It has sold or leased some computers at a loss for the purpose or with the effect of hindering competition:

(j) It has offered discriminatory prices and other concessions to hold its existing customers and to thereby discourage them from replacing Defendant IBM's computers with customers manufactured by others, including:

(i) The allowance of substantially reduced rentals on its installed computers during, and sometimes beyond, the period such computers are being replaced, but only if they are being replaced by Defendant IBM's computers; and

(ii) The allowance of a portion of the rentals paid Defendant IBM by a user with respect to an installed computer as a credit toward the purchase of that computer or, more significantly, toward the purchase of a different model computer, provided it is a computer manufactured by Defendant IBM:

(k) It has marketed and tied together as a package certain products and services, such as maintenance services to leased computers as well as certain software to sold or leased computers, rather than separately pricing each product or service, for the purpose or with the effect of:

(i) Preventing the creation of hardware maintenance companies independent of computer manufacturers:

(ii) Hindering the development of software companies independent of computer manufacturers;

(iii) Camouflaging the grant of discriminatory prices and concessions; and

(iv) Requiring any potential competitor in the computer markets or submarkets to have large aggregations of capital in order to effectively compete;

Exploitation of size to structure the computer markets and submarkets

(l) It has set technical standards, frequently unnecessary and without prior notice to the industry or customers, which standards were in part designed to or had the effect of reducing the marketability of the computers or peripheral equipment of its competitors, permanently or at least temporarily until such time as they conformed to such standards or until customers determined that the standards were not required;

(m) It has formed joint ventures with its customers and customer groups on a discriminatory basis to develop new computer program languages for use in its marketing efforts, and has then used its predominant position in such ventures to deny Plaintiff and other competitors and their customers participation therein or access to the achievements thereof;

(n) It has created an undue financial burden on its competitors and potential competitors, prevented development or growth of independent computer maintenance organizations and a used computer market and, generally, retained control over the majority of computers in use and promoted continuous customer dependence on and contact with it, by consistently encouraging leasing and discouraging sale of computers in the following ways, among others:

(i) Trading upon customers' fear of rapid obsolescence of computers as a market characteristic, and compounding that characteristic by repeatedly, and often unnecessarily, introducing new models, rapidly changing model numbers and otherwise creating uncertainty and confusion among customers;

(ii) Pricing its computers to make leasing costs, either in fact or in appearance, economically more advantageous than purchase costs, particularly as compared with prices of its competitors;

(iii) Increasing maintenance charges on purchased computers without corresponding increases for maintenance included in rental prices;

(iv) Making available certain of the price concessions referred to in subparagraph (j) above to customers leasing its computers but not market comparable concessions to purchasers;

(v) Establishing low trade-in values for used computers which were initially sold new by it despite maintaining resale prices for its used computers at levels near the price for new computers of the same model;

(vi) Lowering charges for overtime use of rented computers without corresponding decreases in purchase prices; and

(vii) Adjusting the discount available for purchase of installed computers on rental with the effect of discouraging immediate purchase;

(o) It has unreasonably stressed and exploited its predominant market position by, among other things carrying on multimillion dollar advertising campaigns wherein it has touted, for example, its extensive installations of computers in all industries and geographical areas, its software library and the libraries of its user organizations as well as its massive force of systems analysts, maintenance, and other personnel, all in order to lead customers to believe that its computers, software, and total services are superior to Plaintiff's and other competitors' and that it above all other competitors offers complete understanding of and solutions to the diverse porblems, requirements, fears and desires of all customers;

Coercion of employees

(p) It has encouraged its salesmen and other personnel to employ the marketing practices alleged herein and other anticompetitive practices by imposing unreasonable quotas and severe penalties for the loss of orders, customers, or prospects;

(q) It has imposed unreasonable barriers against its emloyees working for competitors following termination of their employment with Defendant IBM;

Coercion in and improper influence of customer procurements

(r) It has directed threats, expressed or implied, and other forms of intimidation and coercion, at customer procurement personnel to influence their judgment and induce the acquisition of its computers without regard to price or performance and thereby discourage and prevent the acquisition of computers manufactured by competitors;

(s) It has offered computers to customers upon terms which include an unreasonable requirement of immediate acceptance by the customers, thereby imposing unreasonable pressure to decide immediately without giving due consideration to computers of competitors;

(t) It has, upon learning of a customer's impending decision to acquire a competitor's computer, sought to delay or impede that decision by reopening the evaluation or submitting new proposals, and it has otherwise wrongfully interfered with and attempted to terminate negotiations or contracts between customers and competitors, thus delaying or depriving competitors of sales and creating additional expenses for customers;

(u) I has unreasonably refused to extend leases of its computers, pending the delivery of replacement computers, for customers who have contracted to replace such computers with those of competitors;

(v) It has participated or attempted to participate with customers in the preparaion and evaluation of plans for procurement, specifications, requests for procurement and "benchmark" tests for the purpose or with the effect of preventing such customers from enjoying the advantages of competition as well as depriving competitors of sales;

(w) It has discouraged and sometimes refused to allow or to perform, tests comparing the performance of the computers proposed by it with the performance of the computers proposed by competitors, and on certain of those occasions where competitive tests have been insisted upon and undertaken, it has misrepresented the performance of its computers on such tests;

(x) It has unreasonably exploited the fact that a substantial number of procurement personnel employed by customers formerly were employed or trained by Defendant IBM or trained on its computers and it has caused or arranged for its officers, directors or employees to serve as officers, directors, consultants to, or employees of customers, as well as causing or arranging for representatives of customers to hold similar positions with it, all for the purpose or with the effect of influencing customer procurement decisions and depriving competitors of sales;

Reciprocal marketing practices

(y) It has built or located its plants and other facilities near the geographical locations of certain key customers, or it has referred to the probabilities of such action in the course of its efforts to market computers, for the purpose or with the effect of inducing he acquisition of its computers;

(z) I has utilized its reciprocal buying power to influence the computer procurement decisions or customers;

(aa) It has discriminatorily bestowed favors on certain selected customers, or their employees, by offering or making grants of funds or other economic assistance to such customers or employees, but tying said grants or assistance to a condition that its computers be acquired or retained by such customers;

Disparagement

(bb) It has unfavorably represented and falsely disparaged Plaintiff's computers, sofeware, maintenance policies, personnel, financial position and overall capabilities;

Exclusionary contract practices

(cc) It has employed very informal, and frequently oral, negotiating and contracting techniques for the purposes or with the effects, among others, of encouraging premature customers preparation for receipt of its computers and of camouflaging and facilitating the unfair practices alleged herein. Said techniques have included:

(i) The urging of customers to give to it informal orders or "letters of intent" to acquire an IBM computer, containing no terms or specifications and ostensibly designed to merely reserve for the customer a place on its delivery schedule without legally committing the customer, except that thereafter it pressures the customer to confirm its order or supposedly be eliminated from the delivery sequence;

(ii) The use of master contracts for many customers, originating with the first equipment the customer ever acquired from Defendant IBM—frequently tabulating equipment—and accordingly lacking written particulars concerning the terms, specifications, prices or manpower commitments made by Defendant IBM for the customer's subsequent computer procurements;

Discrimination against other computer manufacturers and their customers

(dd) It has taken advantage of Plaintiff's and other of its competitors' dependence upon it as a source of certain peripheral equipment and supplies by refusing to deal with such companies, or by insisting upon restrictive terms and conditions, for the purpose or with the effect of financially injuring Plaintiff and other manufacturers and preventing them from competing;

(ee) It has established production and delivery schedules for replacement parts and components produced by it which are designed to give preference to users of its computers and discriminate against the users of Plaintiff's or other competitors' computers who, as part of their computer systems, must have access to replacement parts and components produced by Defendant IBM, to the detriment of its competitors and their customers;

Bait and switch

(ff) It has deceived customers and deprived Plaintiff of sales by securing contracts, commitments, or letters of intent from customers for computers, particularly large size computers, and have eliminated its competitors, sought to cancel the contract, commitment, or letter of intent and in lieu thereof, either market a computer more likely to be developed or delivered by it, or a more expensive computer more likely to fulfill the promises made to the customer;

Nonsequential deliveries

(gg) It has rearranged and manipulated its delivery schedules for computers in the light of competitive considerations by offering discriminatory delivery preferences to some customers at the expense of others;

Joint marketing

(hh) It has engaged in joint marketing efforts with The Service Bureau Corporation, its wholly owned subsidiary, and has used said subsidiary as well as its data centers and test centers as vehicles through which to lock-in customers and through which to grant discriminatory price concessions including free usage of computer time, free manpower for software support, and buybacks of computer time or programs;

Consent decree

(ii) It has, contrary to the terms, conditions and intent of its 1956 Consent Decree, directly entered into the time-sharing service business, thereby exploiting its position as the dominant computer manufacturer as well as locking in potential computer customers;

Patents

(jj) It has acquired several thousand United States and foreign patents, patent rights and options to obtain patent rights pertaining to computers and has used its patent position to entrench its monopoly power; and

Acquisition

(kk) It acquired in 1964 the assets and business of Science Research Associates, Inc., a firm engaged in the development and publication of instructional materials in basic subjects for elementary schools, high schools, and universities, and the development and production of a variety of intelligence, aptitude and achievement tests, thereby entrenching its position in the developing market of computerized education.

VI. DAMAGE TO PLAINTIFF

24. The aforesaid violations by Defendant IBM have been the cause of substantial and irreparable damage to the business and property of Plaintiff in that, among other things, Plaintiff has been temporarily and often permanently deprived of innumerable sales and leases of computers. As a result, Plaintiff has lost significant revenues and profits from such sales and leases of computers and peripheral equipment and from the providing of related software and maintenance services. Additionally, Plaintiff has been deprived of profits which, but for the aforesaid violations, would have been realized in connection with sales or leases of computers in fact made by Plaintiff. In turn, the direct loss or delay of revenues and profits has, among other things, greatly impaired Plaintiff's growth and development, including technological development, with the consequent further loss of additional sales and leases. In some instances, Defendant IBM's illegal conduct has barred Plaintiff from marketing computers in an entire computer

submarket. The actual damage to the business and property of Plaintiff from the illegal conduct of Defendant IBM is thus extensive, the exact amount of which remains to be determined.

25. The illegal conduct of the Defendant IBM herein complained of is of a continuing nature. Unless enjoined, Defendant IBM will not refrain from doing the things complained of and the unlawful activities will continue to the further irreparable loss and damage of Plaintiff. In addition, customers and the public will continue to suffer considerable financial damage, to be discriminated against, to be confused and have their operations disrupted, and generally to be deprived of the benefits of free and unrestrained competition in the computer markets and submarkets. The Plaintiff has no complete and adequate remedy at law.

VII. PRAYER FOR RELIEF

Wherefore Plaintiff prays:

(1) That the Court adjudge and decree that Defendant IBM, directly and through combination and conspiracy with its subsidiaries, has attempted to monopolize, has combined and conspired to monopolize, and has monopolized the interstate and foreign computer markets and submarkets in violation of Section 2 of the Sherman Act.

(2) That the Court issue an injunction restraining Defendant IBM, its officers, directors, employees, agents, representatives, and successors, from engaging in the aforesaid violations of law, and from engaging in the specific exclusionary practices alleged in paragraph 23 (a) through (kk) and any other practices found to be exclusionary.

(3) That the Court decree such affirmative injunctive relief, including dissolution of the business or divestiture of properties of Defendant IBM, or enter such orders as may be necessary to dissipate the effects of the violations alleged herein and to insure competitive conditions in the computer markets and submarkets.

(4) That a judgment be entered in favor of the Plaintiff for treble the amount of its actual damages, as provided by law.

(5) That the Court allow, and that Defendant be required to pay, the full costs of this suit, including as a part thereof a reasonable fee for the services of Plaintiff's attorneys.

(6) That the Plaintiff be granted such other, further and different relief as the nature of the case may require and as may seem just and appropriate to this Court both to promote competition and protect computer customers and the public.

OPPENHEIMER, HODGSON, BROWN, WOLFF & LEACH,
By JOHN G. ROBERTSON,
Attorneys for Plaintiff.
St. Paul, Minn.

JURY DEMAND

The Plaintiff, pursuant to Rule 48 of the Federal Rules of Civil Procedure, does hereby demand a jury trial of all the issues of fact raised by its Complaint herein except as to the equitable relief demanded.

Exhibit 3.—*Control Data Divestiture Plan*

ACHIEVING EFFECTIVE COMPETITION IN THE COMPUTER INDUSTRY

A Plan for Divestiture

INTRODUCTION

IBM's monopolization of the manufacture and sale of general purpose digital computers is founded upon its dominant share of the market. Effective relief requires reducing significantly IBM's market share; no half-way measures will suffice to achieve effective competition. Non-structural remedies were tried in the *United Shoe* case with a demonstrable lack of success (divestiture being initially rejected by the district court because of United's single-plant operation—a reason not obtaining here), and the Department of Justice emphasized in its

brief to the Supreme Court (on page 24) that the elimination of a defendant's "monopoly share" of the relevant market went to the heart of relief in a monopolization case:

"Monopoly power is obviously inconsistent with workable competition. The latter term, when used in the context of relief in a monopolization case, can only be read to describe a market where no competitor has a monopoly share * * *"

All this is well established anti-trust policy and good anti-trust economics. But there remains concern that structural relief in this industry is not economically feasible; that the massive size of IBM can only be reduced by imposing substantial social costs on the economy in terms of foregone efficiency. There is the related concern that the only feasible structural relief will still be inadequate to restore effective competition as for instance, by transferring the market power of one monopolist to two duopolists who together control the market.

The purpose of this memorandum is to show that a closer analysis supports a quite different view—that structural relief can be both adequate for achieving competition and accomplished without significant social costs for the economy.

The general proposition is demonstrated here by examining an exemplary plan for horizontal divestiture.[1] The plan also contains divestitures of IBM activities in related markets and limitations on IBM's anti-competitive practices. These ancillary measures are designed to complement and strengthen the pro-competitive effect of divestitures in the general purpose digital computer market.

This plan should not necessarily be regarded as definitive. Rather the plan is intended to document a simple but important conclusion: structural relief is not only necessary if competition is ever to be achieved, but clearly feasible without substantial cost to the economy. Accordingly, a decree containing only prohibitory injunctive provisions, whether such be consented to by IBM or entered by the court after trial, would be inadequate and contrary to the public interest.[2]

A DIVESTITURE PLAN

The central feature of the divestiture plan is the creation of five independent computer manufacturers from existing IBM product lines and facilities. Accompanying such a horizontal divestiture are interrelated proposals and divestitures regarding IBM's activities in other than the computer markets and measures proscribing IBM's anti-competitive practices.[3]

A. *Divestiture of computer manufacturing capability*

This section first describes the plan for computer manufacturing and then evaluates its feasibility, its effect on competition, the possible costs to the economy in terms of economies of scale and its fairness to stockholders, executives and employees.

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[1] As an alternative to divestiture, measures designed to foster (and ultimately require) a *gradual* reduction in IBM's market share could ultimately provide the necessary structural relief, although the arrival of effective competition would be delayed. Thus, if IBM's rate of growth was, for a number of years, something less than that of the overall market—although it would still grow faster than most large corporations—the competitive disparity between IBM and its competitors would gradually narrow. Generally, since IBM would be left basically intact, such an approach woud require a number of stringent prohibitions directed against IBM anti-competitive behavior, the divestiture of certain activities outside of the computer market, and a mechanism in the nature of a "failsafe" provision whereby the market would be frequently examined to verify a decline in IBM's market share. In the event that it was not declining, contingent provisions would come into pay which would virtually compel such reduction. If of interest to the Department, further detail concerning this approach can be made available. At this time, however, while clearly feasibkle—and ultimately effective—immediate horizontal divestiture appears preferable to such an alternative.

[2] The following excerpt, from the staff of House Committee on the Judiciary, 86th Cong., 1st sess., Report on Consent Decree Program of the Department of Justice (committee print 1959), p. 27, is particularly applicable to the computer industry: "In its effort to reduce the relative proportion of consent decrees to litigated judgments, consideration should be given by the Department to the type of issues involved and the economic significance of the proceeding. When novel questions of law are presented, or, when the Government's complaint attacks the structure and operations of dominant corporations that determine the standard of conduct for an entire industry, only in the most extreme situation should a negotiated settlement be undertaken by the Government. Compromise of the Government's position in such a case is not warranted, and a consent decree should only be assented to by the Government when the defendants agree to all of the relief which the Department of Justice believes is essential to reestablish competition, eliminate the conditions which caused the Government to institute its action, and to dissipate the fruits of monopoly."

[3] A "chart" summarizing the following divestiture plan is attached as "attachment 1."

1. The plan

(*a*) *Central processing unit* (*CPU*) *manufacture* is the initial consideration for horizontal divestiture.[4] "Attachment 2" to this paper is an excerpt from an IBM sales manual, and indicates its principal domestic plants engaged in manufacturing computer equipment. Thus, it appears that IBM manufactures CPU's at several U.S. plants, each concerned principally with one "segment" of the IBM product line. For example, the principal manufacturing locations for IBM's *current line* CPU's include:

(1) Boca Ratan, Fla.—System/3, 1130, and 2020 (360/20):

(2) San Jose, Calif.—1800;

(3) Endicott, N.Y.—2025 (360/25) and 2030 (360/30);

(4) Poughkeepsie, N.Y.—2040 (360/40), 2044 (360/44), 2050 (360/50), 2091/95 (360/91–95), and 2195 (360/195);[5] and

(5) Kingston, New York—2065 (360/65), 2067 (360/67), 2075 (360/75), and 2085 (360/85).[6]

In addition, attachment 2 indicates that there are five principal domestic manufacturing locations for certain of its peripheral devices. Although there are exceptions and a certain degree of overlap, the nature of the devices produced at these U.S. locations generally fits the following pattern:

(1) Kingston, N.Y.—Display units (Prefix "22--");

(2) San Jose, Calif.—External "high speed" storage devices, such as disk, drum, and core (Prefix: "23--");

(3) Boulder, Colo.—External "slower speed" storage devices, such as magnetic tape units (Prefix: "24--"):

(4) Rochester, Minn.—External card I/O devices (Prefix: "25--"); and

(5) Raleigh, N.C.—Communications equipment (Prefix: "27--" and "77--").

This organization of principal domestic manufacturing operations and facilities provides the basis for the creation of the following five independent computer equipment manufacturers, presumably by stock distributions to present IBM shareholders:

(1) IBM–A ("Small Scale Computer Company") would receive IBM's Boca Ratan manufacturing facilities and thus responsibility for marketing, integration, and assembly of System 3 and the 1130 and 360/20 computer systems.

(2) IBM–B ("Process Control Computer Company") would be allocated the San Jose manufacturing facilities, and responsibility for marketing, integration and assembly of the special purpose 1800 computer system.

(3) IBM–C ("Small/Medium Computer Company") would receive responsibility for the 360/25 and 360/30 computer systems, and thus IBM's Endicott, N.Y., plant.

(4) IBM–D "Medium and Very Large Computer Company") would be allocated the 360/40, 360/44, 360/50, 360/91, 360/95, 360/195, and 370/155. Accordingly, this company would receive IBM's Poughkeepsie, N.Y., manufacturing facilities.

(5) IBM–E ("Large Scale Computer Company") would receive IBM's Kingston, N.Y., manufacturing facilities and thus be responsible for marketing, integration and assembly of the 360/65, 360/67, 360/75, 360/85 and 370/165 computer systems.

In addition to the foregoing, the principal domestic locations of IBM peripheral manufacture would also be distributed among these five companies, ideally in such a manner as to equalize the potential revenues of the successor companies. Although it is evident that any final determination of which peripheral facility to assign to which company (1) must be considered in the light of IBM's product line and facilities at the time of such divestiture and (2) will depend upon determination, presumably from IBM records, of the dollar value of and market value for various peripheral devices at such time, given today's market and reasonable estimates concerning the future, the following would appear to be a logical distribution of IBM's major peripheral facilities at this time:

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[4] "Central processing Units" are used as the initial building block since they tend to "define" the computer system and since they are far and away the single most expensive element in a computer "system". IBM's EDP peripheral products are, however, also generally considered in this section and part (b) below discusses considerations in computer system integration and assembly.

[5] Although not included in attachment 2, IBM's press release announcing its new "370 Series" on June 30, 1970, stated that the 370/155 would also be produced at Poughkeepsie, N.Y.

[6] The press release referenced in the preceding footnote identified Kingston, N.Y., as the site of production for the new 370/165.

(1) IBM–A would receive the Rochester, Minn., facilities for two reasons. First, this location was heavily involved in the development of System/3, and its products are generally associated with the "mini" or "sub" computer area. Second, while substantial, the revenues and market position of IBM–A are such that to equalize its potential with that of other "new IBMs", a major peripheral facility is justified.

(2) IBM–B would receive the San Jose peripheral device facilities. The fact that the 1800 is produced in San Jose supports the allocation of such a geographically co-located facility. More importantly, however, since the 1800 is a special purpose computer with a more limited market and revenue potential, it is important that a major source of peripheral revenue be allocated to IBM–B. High speed memory devices are a major source of IBM revenue, and would fill this role nicely.

(3) IBM–C, due to the dominant market position of the 360/25 and 360/30, would not receive any major peripheral facility.

(4) IBM–D would also not receive a major peripheral facility, since it would be a tremendously powerful company in its market area.

(5) IBM–E, while dominating the large computer market, would be allocated the Kingston, N.Y., peripheral facilities since the relative market importance of this peripheral facility is not such as to outweigh the fact of its co-location with IBM–E.

It will be noted that the foregoing allocation of perhipheral facilities among the new companies leaves open the issue concerning which would receive IBM's present facilities at Boulder, Colo., and Raleigh, N.C., as well as additional plants established prior to divestiture. This is, in part, to afford flexibility—one or more of these "remaining" facilities could be assigned to such companies as appeared "weak" relative to their "sisters" (given the facts available at the time of divestiture), such facilities could be "substituted' to some degree for those discussed above, or separate companies producing such peripheral devices could be created. With respect to IMB's Raleigh, N.C., plant, creation of a separate company is recommended in light of the fact that communication terminals are expected to represent a large portion of the dollar value of systems and are the fastest growing portion of the computer market. Finally, it is recommended that IBM's present Federal Systems Division also be spun-off as a separate company. This division makes special purpose computers, largely for government use, at Owego, N.Y., and other locations. Thus, IBM–F would become "The Terminals Company" and IBM–G would become the "Federal Systems Company".

The divestiture plan meets the obvious criteria of practicality; no existing product or plant is divided among firms. Of course, by breaking up one or more existing plants, as advocated by the Justice Department in its brief concerning relief in the *United Shoe* case, many additional divestiture alternatives emerge.[7] Under the foregoing plan, however, each company would be allocated at least one large former IBM plant (over 5000 employees) which is now the manufacturing center for a CPU and an assembly point for its systems. The obvious economies of scale of manufacture—those at the plant level—are thus preserved.

(*b*) *Computer system integration and assembly* is, to some degree, accomplished at the site of CPU manufacture. As attachment 2 makes obvious, however, certain IBM peripheral devices are ordered directly from their point of manufacture and then "field merged" into the computer system at the customer location. The proposed divestiture plan would not prevent continuance of this procedure, albeit in a slightly different manner. Since no single successor computer manufacturer would have a full peripheral line—at least initially—they would necessarily engage in selling to one another and each would be partially dependent on purchased peripherals. In this respect, they would not differ from

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[7] In its effort to minimize relocation of IBM activities, this divestiture plan does not necessarily create the optimum "match" of product lines. For example, IBM–B would be particularly "small" as a computer "system" company while very strong in the peripheral area. IBM–C would be "weak" relative to IBM–D and IBM–E, and IBM–D would not only be tremendously large and powerful in the "systems" market but rather illogically "brackets" IBM–E with "medium" and "very large" systems. It is entirely possible that with a very modest relocation of present facilities, an alternative divestiture plan would emerge which would equalize the revenues and potentials of each company in the "systems" markets with entirely harmonious product mixes. The Poughkeepsie plant (IBM–D), for example, may comprise several plants, each principally concerned with a distinct product line. Moreover, introduction of additional "370's" may alter the picture and, in this industry, it is generally conceded that plants can readily be adapted to different products. This only emphasizes the many feasible alternatives available for divestiture based on other premutations available under attachment 2 and resulting from IBM's massive size and market coverage.

the present non-IBM companies. Whether delivery for integration, assembly and testing was requested to be made to the site of CPU manufacture, customer installation location, or elsewhere, would be discretionary with the successor company purchasing the device in light of its complexity.

The successor companies would be required to offer their peripherals to other computer manufacturers on equivalent terms. This provision would help the growth of the non-IBM computer companies, who now cannot otain IBM equipment for integration into their systems at other than a "retail" price. Over time, one would expect that the seven companies would buy peripheral equipment from other than IBM successors as well as develop additional devices to complement their individual product lines.

The effect of these steps would be to open up IBM's closed preserve on its peripherals. IBM peripherals would become more freely available for the systems of other manufacturers and conversely the demand of IBM successor computer companies for peripherals would become open to independent peripheral manufacturers.

The computer business, of course, is more than the manufacture and assembly of hardware. Considered below are the complementary proposals for components, marketing and service, software, and development.

(*c*) *Components* are the even more elemental parts of a computer, including the individual circuits, wire contact relays, switches and the like. The IBM CPU's and peripheral devices use many components in common and the manufacture of components is now grouped in a separate division. It is proposed that this division become a separate company (IBM H—"The Components Company"), selling to the seven IBM successor computer equipment companies, at least until they develop their own capability. As with peripherals, the new components company would also sell to the general market and other components vendors, such as Texas Instruments, would be free to sell to the successor computer manufacturers. One would expect then, a three-fold gain for competition. Components manufacture would have a major new competitor.[8] Other computer manufacturers would have access to IBM components. Other component vendors would have available a new source of demand in the successor computer companies.

(*d*) *Marketing, service, software, maintenance and leasing divides* into two parts: that associated directly with the products of the successor computer companies and that less clearly identified with these companies. A new entity (IBM–I) would be created to take over all these operations which entity would promptly turn over all outstanding leases of computer systems still in production to the successor computer companies responsible for marketing, integration and assembly of such equipment. This would assume a flow of cash to each company from the outset.[9] Each new computer company would thenceforth assume responsibility for maintaining and future marketing of their respective machines by hiring away from the new entity the staff formerly engaged in these operations. Similarly, each new company would be responsible for acquiring personnel to market and support IBM software which existed at the time of such divestiture. Although pre-existing packages would be made equally available to each successor company, development of new programs would obviously thenceforth be an individual responsibility.

The new entity (IBM–I) would then be left with office buildings, perhaps a residual marketing staff, and responsibility for the continued leasing and maintenance of IBM computers (and software) no longer in production. It would have substantial revenues from out of production IBM computers. It could continue as a leasing, maintenance and software company, but to ensure that it did not dominate a new service or market, the new entity would be precluded from acquiring and leasing new computers. As the old machines were returned or sold, the assets could be liquidated and the cash distributed to stockholders.

(*e*) *Development* covers the design of new computers and is, of course, important to survival in the computer industry. There is a tendency, promoted by IBM publications, to think of IBM as one massive development entity. In fact, how-

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[8] Given IBM's massive size, it is possible that the new components company would dominate the semiconductor industry in revenues and value of shipments. If this appears to be the case, further division of IBM's Components Division is possible, since several IBM locations currently produce IBM components.

[9] To the extent that a successor company's major divestiture assets were in the peripheral areas (e.g., IBM–B), any inequity resulting from a transfer of peripheral rentals to the company having systems responsibility could be offset with present IBM cash reserves or other assets held by the "interim" entity.

ever, such key efforts as the design of the System 360 line was done by several teams at different locations and IBM has its present R & D activity located at at least 24 separate laboratories. One—Manassas, Va.,—serves the components division and would be allocated to the new components company. At each of the principal plant locations for the seven hardware companies there presently exist major development groups, as follows:

(1) IBM–A: Rochester, Minn.;
(2) IBM–B: San Jose, Calif.;
(3) IBM–C: Endicott, N.Y., two labs;
(4) IBM–4: Poughkeepsie, N.Y., three labs;
(5) IBM–E: Kingston, N.Y.;
(6) IBM–F: Owego, N.Y.; and
(7) IBM–G: Raleigh, N.C.

The development groups are concerned primarily with the products of the plants near them, so that there would be a natural fit in assigning such groups to adjacent companies. There would remain a few other laboratories that serve a broader corporate function—such as the Thomas J. Watson Laboratory concerned with basic research. These might either be allocated to those companies so as to equalize assets and technical manpower of successor companies or, preferably, transfer or sale of such laboratories to some sort of independent research foundation could be encouraged.

2. Evaluation of the plan

(*a*) *The divestiture plan results in economically strong companies.*—The survey above, operation by operation, indicates that each successor company retains a feasible set of activities appropriate for an independent company. Focusing on these companies as a whole, each would still be absolutely large. Their annual revenue is hard to predict from published IBM data, but the average would be well in excess of 500 million dollars. Another measure of size is the "relative" market share in the computer market. Of course, "relative" market share depends upon the market being defined—for example, in the computer *systems* market, the shares of IBM–C, IBM–D, and IBM–E would be larger than IBM–A and IBM–B, while the latter companies would be considerably more powerful in their respective peripheral areas. However viewed, each company's "share" would be at least twice that of the largest non-IBM company.

Furthermore, the companies would start with substantial financial assets in their share of a multii-billion dollar lease base. (Any sharp inequality in the division of the lease base could be equalized by the differential division of IBM's working capital).

The resulting companies would, of course, be much less vertically integrated than the present IBM. But, as indicated above, the degree of vertical integration would remain comparable to that of other computer manufacturers. There might be particiular facilities imbalances and the management of particular successor companies might regard some greater degree of vertical integration as desirable. But such shifts are relatively easy. IBM now spends about $400 million annually on plant and equipment and such a flow of investment funds would be divided among the successor companies for new investment. The high rate of growth of computer sales—over the ten years from 1959 to 1969 the market growth averaged over twenty percent annually—further enhances the opportunity of the new companies to alter their product lines. In addition, existing computer manufacturing plants are relatively adaptable to different kinds of manufacture. The major capital items in computer manfacture (except for components) are floor space and easily movable test and assembly equipment. Plants can be readily adapted to different products.

Although the new companies initially will have a limited computer line, the fact that they would be compatible would be an initial benefit to the U.S. national defense posture in that compatible computers would be available from multiple sources. In addition, over time, the successor companies could diversify into wider product lines if they so choose and, in so doing, have the financial advantages and manufacturing flexibility described above for vertical integration.[10] In sum, the successor companies should not only be financially viable but economic successes. Each starts with an established product, proven in the market place and with facilities for its manufacture. Each will have access to IBM's present peripherals

[10] Of course, acquisitions by successor companies of each other or other companies would be prohibited for a number of years or, at a minimum, prohibited without prior approval of the Department of Justice.

and components, together with the opportunity to buy such items on the outside market. Each will have the financial security from a big lease base. Each will have a development group and the financial resources to extend its product line horizontally and vertically. Each will have a substantial fraction of IBM's extensive marketing and maintenance force.

(*b*) *The divestiture plan represents a significant step forward in achieving effective competition.*—The plan would still leave IBM products as virtually dominant in separate computer (and peripheral) sub-markets. Thus, the successor computing company would have initially the same market. While high market share in a particular product is a significant source of IBM's market power, IBM's dominance is intensified by the compounding of market power through its position in all the various submarkets and combining such positions with (1) massive financial resources from a huge lease-base; (2) a marketing force that blankets the data processing fields; (3) a complete product line so that customers with changing data needs will continue to be linked to IBM; and (4) a commanding position across product lines as well as with peripherals so that IBM can largely dictate the nature of technological change to its own advantage.

The divestiture plan strikes at these four sources of market power, even though it fails initially to modify the fifth—large share in a specific submarket. Financial power will be reduced because the successor computer companies will no longer be able to exploit the massive flow of funds from one lease base. The marketing force will no longer be ten-to-fifteen-fold the size of competitors and blanket every potential customer. And this marketing force will no longer be able to direct each customer, as his data processing needs expand, from one IBM product to another. Rather, in such situations the customer will evaluate on their merits the products of now independent IBM successor companies relative to those of competitors.

The adverse impact of IBM's monopoly power upon technological change and innovation will be dissipated. With several successor companies, it will be no longer possible for a single firm to paralyze the pace of change in the computer industry by announcements of proposed sweeping product changes or impose its standards on the entire computer manufacturing and user community. Alternative possibilities for procurement will serve both the immediate and long term national interest. To be sure, compatibility is important but absent IBM's massive size, one would expect the initiative for change would be more widely distributed—both among successor companies and other computer manufacturers. Various companies would announce changes and those that met the market test as substantial progress and were followed by competitors and widely accepted by users would become the industry norm. Such a freeing up of technological change would yield a more desirable rate of technological change simply because it would be market tested, rather than the fiat of one organization.

Finally, the divestiture plan does offer the possibility for correction of the dominance by successor companies in particular submarkets. To some extent, there will be immediate competition between the successor IBM companies themselves, since product lines overlap—e.g., a "large" configuration of a 360/30 system competes directly with a minimally configured 360/40. Also, as indicated earlier, it is likely that successor companies will broaden their product lines and so further compete with one another. The availability of former IBM peripherals and components to newcomers and other computer manufacturers on equal terms with IBM successors will encourage the rise of additional competition. The removal of the advantages of IBM's *overall* size and extensive product line will enable the present competitors of IBM to compete more effectively in each submarket, resulting in an increased market position of competitors.

(*c*) *The divestiture plan does not entail any losses in social economies of scale.*—In evaluating the divestiture plan, it is important to distinguish between "social" and "private" losses resulting from the removal of IBM's massive scale. Social economies of scale are true gains for the economy as a whole; private economies of scale are those accruing to the benefit of a single firm and not to the economy. Public policy is concerned only with social economies. And the divestiture plan involves no loss in social economies.

As indicated above, the divestiture plan does not divide either individual plants or products. Hence the only conceivable source of the loss of economies of scale are those operations that encompass several products and plants: namely, financing, the use of common products such as peripherals and components, marketing, providing associated customer services, and development of new products.

The massing of financial power is one example of a private economy of scale. It is an advantage to IBM because it permits it to concentrate development ex-

penditures on certain products and gain a competitive edge. It is not an advantage to the economy because the competitive edge for one company does not necessarily speed up technological progress for the economy. Rather there is considerable evidence suggesting that IBM, while massive in its resources, has not been the technological leader in computer development. IBM competitors, with a lower level of spending, have made many important contributions to the industry's progress.

IBM's vertical integration into peripherals and components again appears to be primarily a private economy of scale. IBM has a private advantage in that its extensive line of peripherals are unavailable to other computer manufacturers except at the retail price. Yet since these terms restrict sharply the use of IBM peripherals by other computer manufacturers, IBM's private gain is a social loss. Since any true scale economies operable with respect to a particular peripheral product would remain intact, the future availability of each such product to all computer companies could thus well convert IBM's private economy to a social economy. Moreover, given the size and growth of the present computer market, there is evidence to suggest that any true scale economies are maximized at levels far below IBM's current production. The same situation is applicable with respect to components.

An extensive marketing service is again a private economy of scale for IBM, giving them a competitive edge. Whether or not one massive marketing service for a complete computer line takes less real resources in terms of manpower than several separate sales forces for the successor companies, and so becomes a social economy, is possible, but unlikely since the computer is not a repeat item sold in considerable volume but, instead, each procurement must be individually tailored and marketed. IBM's present marketing organization is generally organized according to "industry classification," which is often reflected in computer system size; such economies would thus be preserved. Moreover, such manpower economies as may exist with respect to "repeat" customers, due to customer loyalty or the exploitation of other competitive advantage resulting from having a machine "on the inside," would—to the extent worthy of consideration—be preserved and reflected in favor of any previously "successful" vendor regardless of its size.

Maintenance and software are perhaps even less clear a case of minimal economies of scale. These services are now generally organized by IBM in teams specializing in various computers or industries and so the economies of size are limited to such relatively minor items as common office space. Much applications software can be used by several computers but this work is now carried on by independent software companies with some success. Also much of the existing application software would remain available as a separate product as the result of the "unbundling" of computer pricing.

Development is similarly unlikely to reflect significant social economies of scale. As indicated above, IBM's development groups for specific computers and for components are geographically separated and function in large part as separate teams. Moreover, the fact that other computer manufacturers with less extensive development groups have been able to keep pace and often lead IBM's technological progress proves feasibility and suggests that the efficiency difference between very large scale and more modest scale development is not a decisive one for the rate of technical progress. Finally, due in part to its large lease base, IBM has tended to announce and deliver new products in a manner designed to "protect" its lease base and to maintain a "desired" growth rate, thereby denying to society the benefits of competitors' advances as well as such benefits as could even theoretically derive from its own massive development efforts.

(*d*) *The divestiture plan is equitable to IBM's stockholders, executives and employees.*—Although the Supreme Court has recognized the minimal consideration to be given "private interests" in framing effective remedies to redress antitrust violations, *U. S.* v. *duPont*, 366 U.S. 316, the instant divestiture alternative is fair to the interests of such parties. The IBM stockholders will receive stock in all the successor companies in exchange for their present IBM holdings. In aggregate, the same financial and physical assets will be represented by the new stock. Stock in IBM, as opposed to that in successor companies, does provide the financial security of diversification by reflecting wide product line and a wide range of "data processing" activities. Yet stockholders that continue to want such diversification can leave their holdings distributed among successor companies. Those that wish to concentrate on particular activities can rearrange their portfolio to do so. IBM stockholders can thus select varying mixes of activities

if they so wish and, in addition, will be able to select as well as invest in different managements of the various successor companies.

Against this gain must be set a loss in the portion of the value of IBM stock representing monopoly profits. This is an inevitable cost of a public policy directed at eliminating monopolization. Yet in the high growth computer industry such losses should be modest and transitional. While it is obviously foolhardy to predict the course of post-divestiture stock values, the risks seem less than in other major divestitures.

As for IBM executives, divestiture will convert many IBM divisional executives now serving as second or third level management into top management since there will be several top management groups rather than one. The executive losers from divestiture will be confined primarily to the small group of top executives who will forfeit the power and prerogatives of administering one of the world's largest private enterprises.

The successor companies would assume all the obligations of the pension and benefits of the executives and employees in facilities they are assigned. The special leasing company described above (IBM-I) will assume a corresponding obligation for branch and central office employees who are not hired by the successor computer or components companies. This company will have both the extensive office buildings owned by IBM throughout the country and the leases on older computers as assets with which to meet obligations to these employees.

To sum up, the divestiture should preserve much of the significant equities of IBM stockholders, executives, and employees.

B. Divestitures in related markets

The preceding measures are generally directed at the domestic computer hardware market. There remain other components of IBM that should also be divested to IBM stockholders on the grounds that: (1) They can be economically viable companies in their own right; (2) assigning any one to a particular successor computer company would make successor companies unequal in size; and (3) the particular operations are so large in their respective markets and so closely related to the marketing of computers that ownership by such a computer company jeopardizes competition in the computer market.

Four IBM operations particularly fit these conditions: The Service Bureau Corporation (SBC), the Office Product Division, Science Research Associates, and the World Trade Corporation.

1. The divestiture of SBC

Under the 1956 Consent Decree, SBC is supposed to be operated as an arms-length corporation. Yet there is considerable evidence that its computing services promote IBM's computer business through "customer captivity" as well as through offering IBM opportunities to institute price discrimination through the free usage of computer time, free manpower or software support, and buy-backs of computer time. Furthermore, it provides a sheltered market for IBM equipment. As a result, SBC is another source of IBM market power in the computer business.

The divestiture of SBC, through a stock distribution, would prevent this source of market power in the computer market from being utilized by any successor computer company.

2. The divestiture of the Office Products Division

IBM's office products operations are organized as a separate division, with its own plants, development group, and executive organization and with revenues in the hundreds of millions of dollars. The principal product of this division is office typewriters in which IBM has a substantial market share. In addition, IBM recently announced entry into the office copier market. This division should have no difficulty operating as a separate company. While at present the interrelationships between office products and computers are not extensive, the coupling of magnetic-tape to typewriters and copiers could give a computer manufacturer with a large share of outstanding office typewriters and an entry in the copier market a powerful position in the computer market. Accordingly it is proposed that the Office Products Division be divested into one or more separate companies.

3. The divestiture of Science Research Associates (SRA)

SRA is a recent IBM acquisition which develops and markets computer applications in the educational area. It is an asset in the marketing of computers which should not be assigned to any one particular successor company. Since

SRA has previously been successful as a separate company, it can be easily reestablished in this status.

4. The divestiture of the World Trade Corporation

IBM has concentrated its foreign operations in a single subsidiary—IBM World Trade Corporation. This subsidiary can be a separate company for it already has its own overseas marketing force, extensive manufacturing and development activities, and a distinct set of executives. As a separate company, it would have over a billion dollars in annual revenues.

As a separate company, however, at least initially, World Trade would have to buy some products it does not manufacture from successor companies. And it is likely to need to license technological know-how from successor companies to stay abreast of changing technology. But these relationships would have a somewhat lesser impact on domestic competition than the existing ones.

The impact of a dominant position in many markets abroad would presumably be diffused among several successor computing companies. At the same time, the impact on American trade from divestiture would be minimal since World Trade in effect now buys many of its products from IBM's domestic operations. Over the longer run, World Trade could buy from other American computer manufacturers if their products proved superior. Thus World Trade's commanding position in various foreign markets might become available to other American computer manufacturers.[11]

C. Proscriptions against certain anti-competitive practices

Since the divestiture recommendations are fairly comprehensive, the scope of injunctive relief can be limited to a few key items. Nonetheless, since the IBM successors will have, at least initially, very substantial market shares in particular computer and peripheral submarkets, four major provisions are required: limitations on price discrimination, limitations against paper machines and the like; requirements on product disclosure, and provision for royalty-free licensing.

1. Price discrimination

Price discrimination is a traditional tactic of a dominant firm to gain and to maintain market power—cutting prices for a group of customers or with respect to products where competition is vigorous while maintaining high prices elsewhere. IBM has made extensive use of price discrimination. Given IBM's record, the importance of price discrimination as a source of market power, and high market shares in many computer lines even after divestiture, injunctive provisions are required to eliminate price discrimination.

Price discrimination can be eliminated by requiring IBM to institute "auto-sticker pricing". Such pricing would have the following features:

(*a*) Each successor company and WTC would be required to publish a separate list price, together with terms of sale such as credit, trade-in allowances, etc., for (i) each unit of the computer, (ii) software (such as each operating system, compiler, assembler, application, and special user program), (iii) maintenance services, (iv) programing services, (v) customer training, (vi) other products or services related to the sale and support of computers. This would extend and make mandatory the present practice of "unbundled" prices.

(*b*) All sales (except competitive bids to a government agency) must be at the list or "sticker" price and at published terms except as justified to meet competition. Each product or service priced separately must be available for purchase separately and profit margins on different products or services must

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[11] The disposition of World Trade is quickly becoming, however, a particularly vexing problem, in light of its large size, fantastic growth, and emerging "independence" as a manufacturing and developing entity as well as a foreign marketing arm of IBM. Statistics indicate that World Trade dominates the foreign markets almost to the extent of IBM's U.S. domination—and more so vis-a-vis its U.S. competitors. This strongly indicates that World Trade should itself be further divided into several independent companies, perhaps along geographical lines. The feasibility of this is clear, in light of the fact that World Trade is organized merely as a holding company for the stocks of subsidiaries incorporated under the laws of over 100 nations. Further facts are necessary to evaluate the manner in which such foreign subsidiaries could be realigned into several viable companies, with similar or at least potentially equal manufacturing, research and marketing capabilities. It is entirely possible that multi-nation companies with product lines not dissimilar to those created in the new IBM–U.S. companies could be feasibly created and held by several independent U.S. holding companies. Whatever the approach, it is becoming increasingly clear that the present worldwide power of World Trade should be diffused as part of any structural remedy in the U.S. market, or else U.S. computer companies—including the "new" IBMs—may find penetration of foreign markets impossible, and World Trade may itself turn to and dominate the U.S. market.

be reasonably similar. Such provisions would restrain price discrimination directly by requiring uniform prices to different buyers, prevent any single item from being tied to another (often hiding price discrimination), and prevent any item from being offered at a low profit margin. It would eliminate the so-called educational discount.

(*c*) All sales offers, bids and proposals would be made in writing containing the above prices, delivery date, and other terms and conditions, and the customer would be allowed 30 days to accept or reject the proposal or any part of it. Orders would be filled in the order of their receipt. This would prevent hidden price discrimination via oral agreements, prevent the practice of stampeding a customer into accepting an order, as well as prevent discrimination between customers via delivery dates.

(*d*) To prevent subtle forms of price discrimination, grants to a customer or participation in joint ventures or projects to induce a purchase of a computer or related service would also be prohibited.

2. Paper machines, programs and the like

This practice can be reached by a provision prohibiting successor computer companies and WTC from offering, advertising or otherwise disclosing to the trade any computers, programs, or related equipment prior to an operational demonstration of such item. These demonstrations are to be open to competitors and the public and the operational characteristics demonstrated must conform to the advertised specifications, which specifications must themselves contain sufficient detail as to be meaningful. Such demonstration shall not be held prior to the time the products or services are ready for manufacture and distribution in production quantities, thus insuring quotation of realistic delivery schedules.

3. Product standards and compatibility

One characteristic of IBM's vast market share is that by its dominance it creates certain standards on a de facto basis to which its competitors must conform, thus raising difficulties for other manufacturers in making their equipment compatible with that of IBM. While dividing IBM's product line among several companies reduces the scope of the problem, the dominance of successor companies in particular markets still leaves a potential threat to competition from sharp changes in product standards by the firm with the dominant market share. Without prior notice of such changes, competitors are placed at a substantial disadvantage. Accordingly, with respect to all new or proposed products or software which have characteristics which will affect information interchange or interface between a successor company's or WTC's systems and competitive systems, such companies and WTC should be required to disclose confidentially to every U.S. computer manufacturer complete functional specifications of all such new products and software and of each major change in existing products and software 24 months prior to their first delivery. The particular standards which require disclosure relate to devices utilized for information interchange in general and particularly those that involve interchangeable media. Some mechanism would have to be devised to prevent the abuse of this requirement by disclosing new standards which subsequently are not actively marketed.

4. Royalty-free patents

IBM and WTC now have thousands of U.S. and foreign patents and patent rights, relating to computers which constitute one source of its market power. To give the portfolio to any one successor manufacturer would give that company a major edge over others and provide the basis for new positions of market power. To divide the portfolio would necessarily require extensive patent cross licensing between competing companies. The simplest solution would be to establish royalty-free licensing of all IBM's present patents.

CONCLUSION

Major structural relief in the computer industry is an absolute necessity. The divestiture plan outlined herein promises such effective structural relief as will enhance competition and promote the public interest in a strong computer industry without jeopardizing the national security. It protects the ability of IBM successors to prosper, to innovate and to contribute to a competitive computer industry. It demonstrates that effective competition can be achieved without significant social costs for the economy.

[illegible]

Legend: B = [illegible] P = [illegible], N. Y.
E = [illegible] Q = [illegible]
F = [illegible] R = [illegible]
L = [illegible] S = [illegible]
N = [illegible], Fla. T = [illegible], Canada

Control — [illegible] — Shipment — Manufacture

[Numbers refer to footnotes below]

[illegible] If the [illegible] components at all, [illegible] of the system.

Field [illegible] will depend [illegible] of the [illegible] units and systems.

OTHER [illegible]

SYSTEM/3	N N N
EXCEPT	
1255	N E N
5203	N L N
5424	N P N
5440	S S S
5444	[illegible] S N
5475	N O N
103	
108	L L L
539	P P P
867	L L L
305	S S S
EXCEPT	
407 P	L E L
357	Q Q Q
EXCEPT	
24	P P P
26	P P P
632	T T T*
858	P P P
870	P P P
1001	
24	P P P
26	P P P
1001	Q Q [illegible]
1030	Q Q Q
1050	Q Q Q
EXCEPT	
1057	P P P
1058	P P P
1060	Q Q Q
1070	S S S
EXCEPT	
1053	S Q S
1050	S S S
EXCEPT	
1053	S [illegible] S
2055	S [illegible] S
1057	S P S
1058	S P S
1082	S Q S
1130	N N N
EXCEPT	
1055	N Q Q
1132	N E E
1231	N [illegible] N
1403	N Q Q
1442	N E E
2250	N E [illegible]
2310	N S S
2501	N R R

1200	E E E
EXCEPT	
1301	E S L
1311	L S S
1442	L R E
1443	E Q [illegible]
1444	E P L
7335	E K L
1401	L E E
EXCEPT	
729	E B 2
1011	L S 2
1012	E S 2
1026	E Q 2
1231	E P P
1311	E S S
1402	L R 2
1403	E Q 2
1405	E S 2
1407	E S 2
1445	E Q [illegible]
7155	B B B
7330	E K 2
7340	E B 2
7641	E P 2
1410/7010	P P P
EXCEPT	
729	P B B
1009	P E E
1011	P S P
1014	P E E
1301	P S S
1311	P S S
1402	P R R
1403	P Q Q
1405	P S P
1412	P E P
1416	P E E
1419	P E P
1442	P R R
2312	P S S
7330	P K P
1440	S S S
EXCEPT	
1026	S Q Q
1231	S R R
1403	S Q Q
1412	S E [illegible]
1442	S E [illegible]
1443	S Q [illegible]
1444	S P [illegible]
1448	S E S
7335	S K [illegible]
7631	S P [illegible]
1450	
[illegible]	E Q E
1259	E E E
1311	E S E
1441	E E L
1442	E R E
1443	E Q E
1447	E S E

1050	E E E
EXCEPT	
[illegible]	E B D
1011	E S E
1012	E S L
1026	E Q Q
1231	E P K
1301	E S E
1311	E S S
1402	E P R
1403	E [illegible]
7155	B E D
7330	E [illegible]
7340	L B L
7641	E P L
1400	S S S
EXCEPT	
1443	S Q S
1622	R R R
1627	N N N
1410	S S S
EXCEPT	
1443	S Q S
1622	R P S
1500	S S S
EXCEPT	
1015	S Q [illegible]
[illegible]	S [illegible] S
[illegible]	S Q S
[illegible]	S [illegible] S
[illegible]	S R [illegible]
[illegible]	S Q [illegible]
[illegible]	[illegible]
1615	S Q S
2401	S B S
[illegible]	S P S
[illegible]	S Q Q
2793	S Q Q
[illegible]	S Q Q
2750	S Q Q
2200	Q Q Q
EXCEPT	
50	Q P Q
545	Q 6 Q
[illegible]	S
[illegible]	Q E Q
[illegible]	Q E [illegible]
[illegible]	Q F [illegible]
[illegible]	Q R Q
[illegible]	Q Q Q
EXCEPT	
215	7
2415	K K K
EXCEPT	
[illegible]	K Q Q
[illegible]	Q Q Q
EXCEPT	
2260	Q K K
6400	T T T*

7040/44	K K K
EXCEPT	
729	K B B
1009	K E [illegible]
1011	K S K
[illegible]	K E [illegible]
[illegible]	K S [illegible]
[illegible]	K P [illegible]
1403	K [illegible]
[illegible]	K P [illegible]
[illegible]	K E [illegible]
[illegible]	K R [illegible]
[illegible]	K S [illegible]
[illegible]	K [illegible] K
7631	K P K
7090/94	P P P
EXCEPT	
711	P E P
716	P L P
[illegible]	P B P
1009	P E P
[illegible]	P S P
1014	P E P
1301	P S S
[illegible]	P S S
7310	P S P
[illegible]	P S P
[illegible]	P E P
[illegible]	P P P
7550	P R P
[illegible]	P Q P
[illegible]	P Q P
1056	P Q P
[illegible]	P S S
7741	P P P

*F.O.B. Buffalo

10	P P P	188	R R R	954
13	Q Q Q	402	L E E	903
24	P P P	403	E L E	565
26	P P P	407	E E E	1013
27	P P P	408	E L E	1092
33	P P P	409	E L E	1093
43*	8	419	E E E	1201
46	P P P	514	R R P	1202
47	P P P	519	R R R	1203
50	P P P	521	R R R	1210
56	P P P	523	P R R	1219
57*	9	524	P P P	1230
63	P P P	526	P P P	1232
65	P P P	523	R R R	1250
66	P P P	534	P P P	1282
67	P P P	548	R R R	1316
68	P P P	549	R P R	2316
77	R R R	557	P P P	2711
82	E E E	602	S S S	2712
83	1	604	S S S	2740
84	E L E	609	S S S	2741
85	R R P	802	R P R	2750
87	R R R	803	R R R	2730
88	R R R	805	E L E	5426
101	P P P	824	P P P	5555
		826	P P P	7702
				7711

FOOTNOTES

1 [illegible]
2 [illegible]
3 [illegible]
4 [illegible]
5 [illegible]
6 [illegible]
7 [illegible]
8 [illegible]
9 [illegible]

[illegible]

SYSTEM/360

	2020	2025	2030	2040	2044	2050
1017	-	L ( )	F _ E	F _ F	-	F _ P
1018	-	L C L	L C L	F (P	-	F 6 F
1051	-	-	F C L	-	-	-
1052	-	E O F	T C E	P Q P	P O P	P C P
231	-	E P L	E K E	P P P	-	P P P
1259	N E E	E T F	L E F	P E P	-	-
1255	-	E P L	F P E	P R P	-	P E P
1257	-	E K L	E P E	P P 13	-	P F 13
268	-	E P E	F P E	P R P	-	P F P
1403	N & &	E & &	E & &	P & &	P & &	P & &
1404	-	E Q E	E Q E	F Q P	-	F Q P
1412	-	E E E	E E E	-	-	-
1416	N L E	E E F	E E K	P E P	P E P	P E P
1418	-	E L E	E E E	-	-	-
1419 8	N E E	E L L	E E E	P E P	-	P E F
1428	-	E E L	F E E	P E P	-	P E F
1442	N R R	E P I	E R P	P R P	P R R	P F R
1443	-	E C Q	E Q Q	P Q Q	P Q O	P O O
1445	-	E Q L	E Q E	-	-	-
1627 9	-	E S E	E S E	P S P	P S P	P S P
2020	N N N	-	-	-	-	-
2025	-	E E E	-	-	-	-
2030	-	-	E E E	-	-	-
2040	-	-	-	P P P	-	-
2044	-	-	-	-	P P P	-
2050	-	-	-	-	-	P P P
2065	-	-	-	-	-	-
2067	-	-	-	-	-	-
2075	-	-	-	-	-	-
2085	-	-	-	-	-	-
2091	-	-	-	-	-	-
2095	-	-	-	-	-	-
2150	-	-	-	-	-	P K P
2152	N N N	-	-	-	-	-
2167	-	-	-	-	-	-
2195	-	-	-	-	-	-
2203	N 15 E	-	-	-	-	-
2250	-	E K 2	E K 2	P K K	P K K	P E E
2301	-	-	-	-	-	-
2302	-	-	E S S	P S S	-	P S S
2303	-	-	-	T S S	-	P S S
2311	N S S	E S E	E S S	F S S	P S S	P S S
2314	-	-	E S S	P S S	P S S	P S S
2315	-	-	-	-	S S S	-
2321	-	-	E S S	T S S	-	P S S
2361	-	-	-	-	-	P K P
2365	-	-	-	-	-	-
2385	-	-	-	-	-	-
2390	-	-	-	-	-	-
2401	-	E E 3	P B B	P P B	P D B	P E P
2402	-	-	E D 3	P : B	P E B	P L
2403	-	-	E L 3	T P B	[illegible] B B	P B P
2404	-	-	E B B	P I B	P B B	P E
2415 10	N B L	E B B	E B B	P F B	P B B	P c
2420	-	-	E B E	P F P	P B P	P B 1
2495	-	E P P	E P P	P I P	-	P P
2501	N R R	E R F	E F R	P Y P	P P R	P F
2520	N R R	E F P	E P R	P F P	P P P	P P P
2540	-	E F S	E R R	P J R	P P R	P R R
2560	N R R	E R F	-	-	-	-
2671	-	E 6 E	E 6 E	P (P	P 6 P	P 6 P
2701	N Q Q	E Q Q	E O O	P [illegible] Q	P O O	P O O
2702	-	E O O	E Q Q	P (Q	P C O	P C C
2703	-	E O E	E Q E	P (12	P O P	P O 12
2715	-	E O O	E O O	P _ Q	-	P O C
2803	-	E B B	E B H	P 3 B	P B B	P E S
2804	-	-	E B B	P : B	P B E	P B E
2816	-	-	E D B	P ' B	P B P	-
2820	-	-	-	-	-	-
2821	-	E E E	E E E	P , 1	P E 1	P L 1
2822	-	E 6 E	E 6 E	P L P	P 6 P	P 6 P
2826	-	E 6 E	E 6 E	P L P	-	P 6 P
2840	-	-	E K E	P Y P	P K P	P F P
2841 7	-	-	E S S	P : S	P S S	P S S
2844	-	-	E S E	P : S	R S S	P S S
2845	-	-	-	-	-	-
2860	-	-	-	-	-	-
2870	-	-	-	-	-	-
7770	-	E Q F	E Q E	P C Q	-	P C
7772	-	E Q E	E Q E	P Q P	-	P Q T

1 The 2821 ... 1, 2, 3 ... from ... with the 2040, 2044, 2050 and 2065. The Model 4 ... be shipped with the CPU from the [illegible]
2 [illegible]
3 [illegible] 2401, 2402 [illegible]
4 [illegible]
5 [illegible]
6 [illegible]
7 [illegible] 67, 75 and 85

SYSTEM/360

	2065	2067	2075	2085	2091/95	2195
1017	-	-	-	-	-	-
1018	-	-	-	-	-	-
1051	-	-	-	-	-	-
1052	K Q 11	K Q 11	K Q 11	K Q 11	-	P Q 11
1231	-	-	-	-	-	-
1257	-	-	-	-	-	-
1285	-	-	-	-	-	-
1287	-	-	-	-	-	-
1288	-	-	-	-	-	-
1403	K [illegible]	K [illegible]	K [illegible]	K [illegible]	P [illegible]	P [illegible]
1404	-	-	-	-	-	-
1412	-	-	-	-	-	-
1416	K E K	K E K	K E K	K E K	-	P E K
1418	-	-	-	-	-	-
1419 8	K E K	-	-	-	-	-
1428	-	-	-	-	-	-
1442	K R 14	K R 14	K R 14	K R K	-	P R 14
1443	K Q Q	K Q Q	K Q Q	K Q Q	-	P Q Q
1445	-	-	-	-	-	-
1827 9	K S K	-	K S K	K S K	P S P	-
2020	-	-	-	-	-	-
2025	-	-	-	-	-	-
2030	-	-	-	-	-	-
2040	-	-	-	-	-	-
2044	-	-	-	-	-	-
2050	-	-	-	-	-	-
2065	K K K	-	-	-	-	-
2067	-	K K K	-	-	-	-
2075	-	-	K K K	-	-	-
2085	-	-	-	K K K	-	-
2091	-	-	-	-	P P P	-
2095	-	-	-	-	P P P	P P P
2150	K K K	K K K	K K K	K K K	P K P	P K K
2152	-	-	-	-	-	-
2167	-	K K K	-	-	-	-
[2195	-	-	-	-	-	P P P]
2203	-	-	-	-	-	-
2250	K K K	K K K	K K K	K K K	P K K	P K K
2301	K S S	K S S	K S S	K S K	P S S	P S S
2302	K S K	-	K S K	-	-	-
2303	K S S	K S S	K S S	K S K	P S P	P S S
2311	K S S	K S S	K S S	K S S	P S S	P S S
2314	K S S	K S S	K S S	K S K	P S S	P S S
2315	-	-	-	-	-	-
2321	K S S	K S S	K S S	K S K	P S S	P S S
2361	K K K	-	K K K	K K K	-	-
2365	K K K	K K K	K K K	K K K	-	-
2385	-	-	-	K K K	-	-
2395	-	-	-	-	P P P	-
2401	K B B	K B B	K B B	K K K	P B B	P B B
2402	K B B	K B B	-	-	P B B	-
2403	K B B	K B B	K B B	-	P B B	-
2404	K B B	-	K B B	-	P B B	-
2415 10	K B K	-	K B K	-	-	-
2420	K B K	-	K B K	K B K	P B 16	P B K
2495	K P P	K P P	-	-	-	-
2501	K R R	K R R	K R R	K P R	-	P R K
2520	K R K	K R K	K R K	K P K	-	-
2540	K R R	K R R	K R R	K R P	P R P	P R R
2560	-	-	-	-	-	-
2671	-	K 6 K	-	-	-	-
2701	K Q K	K Q K	K Q K	K Q K	P Q Q	P Q K
2702	K Q Q	K Q Q	K Q Q	K Q Q	-	P Q Q
2703	K Q Q	K Q Q	K Q Q	K Q Q	-	P Q Q
[2715	K Q Q	K Q Q	K Q Q	K Q Q	-	-]
2803	K B B	K B B	K B B	K B B	P B B	P B B
2809	K B B	K B B	K B B	K B B	-	-
2816	K B B	K B B	K B B	K B B	P B B	P B B
2820	K S S	K S S	K S S	K S K	P S S	P S S
2821	K E E	K E E	K E E	K E K	P E 1	P E E
2822	-	K 6 K	-	-	-	-
2826	-	-	-	-	-	-
2840	K K K	K K K	K K K	K K K	P K K	P K K
2841 7	K S S	K S S	K S S	K S S	-	P S S
2848	K S S	K S S	K S S	K S K	P S S	P S S
2846	-	K K K	-	-	-	-
2860	K K K	K K K	K K K	K K K	-	P K K
2870	K K K	K K K	K K K	K K K	-	P K K
7770	K Q K	-	K Q K	K Q K	-	-
7772	K Q K	-	K Q K	K Q K	-	-

8 The 1419 is classified as Shipped Direct on the SYSTEM/360 Model 20. Shipped Direct status means each unit will be factory [illegible] on a SYSTEM/360 Model 20 [illegible] to a customer.
9 [illegible]
10 The 2415 [illegible] for the 2065, 2067 and 2075. The 2415 [illegible]
11. All [illegible] 1052 Model 7s [illegible] SYSTEM/360 Models 65, 67 and 75. [illegible] systems with 1052 [illegible]
12 [illegible]
13 [illegible]
14 [illegible]
15 [illegible]
16 [illegible]

A. DIVESTITURE

FIVE COMPUTER MANUFACTURERS

A. Small Scale Computer Company

1. Product: System/3, 360/20 and Card I/O devices.
2. Mfg.: Boca Raton, Fla., and Rochester, Minn.
3. Research: Rochester, Minn.

B. Process Control Computer Company

1. Product: 1800 and high speed memory devices.
2. Mfg.: San Jose, Calif.
3. Research: San Jose, Calif.

C. Small/Medium Computer Company

1. Product: 360/25 and 360/30.
2. Mfg.: Endicott, N.Y.
3. Research: Endicott, N.Y.

D. Medium and Very Large Computer Company

1. Product: 360/40, 360/44, 360/50, 360/91, 360/95, 360/195, 370/155.
2. Mfg.: Poughkeepsie, N.Y.
3. Research: Poughkeepsie, N.Y.

E. Large Scale Computer Company

1. Product: 360/65, 360/67, 360/75, 360/85, 370/165, and display units.
2. Mfg.: Kingston, N.Y.
3. Research: Kingston, N.Y.

TWO "OTHER" HARDWARE MANUFACTURERS

F. Federal Systems Company

1. Product: Present products of IBM's Federal Systems Division.
2. Mfg.: Owego, N.Y. and elsewhere.
3. Research: Owego, N.Y.

G. The Terminals Company

1. Product: Computer terminals.
2. Mfg.: Raleigh, N.C.
3. Research: Raleigh, N.C.

TWO RECIPIENTS OF "COMMON" ASSETS

H. Components Co.

1. Product: Present products of components division—sold to new companies.
2. Mfg.: Present facilities of IBM Components Division.
3. Research: Manassas, Va.

I. Service Co.

Receives all outstanding leases, marketing and maintenance personnel, leases, and software. Successor companies acquire back such assets necessary for contemporary product line only.

FOUR "VERTICAL" DIVESTITURES

1. Service Bureau Corp.
2. Office Products Division.
3. Science Research Associates.
4. World Trade Corp.

"REMAINDER"

Remaining research facilities and manufacturing plants divided "equitably" among five computer companies.

ACHIEVING EFFECTIVE COMPETITION IN THE COMPUTER INDUSTRY

"In its effort to reduce the relative proportion of consent decrees to litigated judgments, consideration should be given by the Department to the type of issues involved and the economic significance of the proceeding. When novel questions of law are presented, or, when the Government's complaint attacks the struc-

ture and operations of dominant corporations that determine the standard of conduct for an entire industry, only in the most extreme situation should a negotiated settlement be undertaken by the Government. Compromise of the Government's position in such a case is not warranted, and a consent decree should only be assented to by the Government when the defendants agree to all of the relief which the Department of Justice believes is essential to reestablish competition, eliminate the conditions which caused the Government to institute its action, and to dissipate the fruits of monopoly," Staff of House Comm. On the Judiciary, 86th Cong., 1st Sess., Report on Consent Decree Program of the Department of Justice (Comm. Print 1959).

OPPENHEIMER, BROWN, WOLFF, LEACH & FOSTER,
Attorneys for Control Data Corp.

Dated: ____________.

IBM's monopolization of the manufacture and sale of general purpose digital computers is founded upon its dominant share of the market. Effective relief requires reducing significantly IBM's market share; no half-way measures will suffice to achieve effective competition.

All this is well established anti-trust policy and good anti-trust economics. But there remains concern that structural relief in this industry is not economically feasible; that the massive size of IBM can only be reduced by imposing substantial social costs on the economy in terms of foregone efficiency. There is the related concern that the only feasible structural relief will still be inadequate to restore effective competition as for instance, by transferring the market power of one monopolist to two duopolists who together control the market.

The purpose of this memorandum is to show that a closer analysis supports a quite different view—that structural relief can be both adequate for achieving competition and accomplished without significant social costs for the economy.

The general proposition is demonstrated here by examining two alternative approaches: (1) Horizontal divestiture and (2) limitations on the growth of IBM to reduce its market share. Each alternative is set forth in an illustrative plan. Each plan also contains divestitures of IBM activities in related markets and limitations on IBM's anticompetitive practices. These ancillary measures are designed to complement and strengthen the pro-competitive effect of measures in the general purpose digital computer market.

Neither plan should necessarily be regarded as definitive. Rather the two plans are intended to document a simple but important conclusion: structural relief is not only necessary if competition is ever to be achieved, but clearly feasible without substantial cost to the economy. Accordingly, a decree containing only prohibitory injunctive provisions, whether such be consented to by IBM or entered by the court after trial, would be inadequate and contrary to the public interest.

I. A DIVESTITURE ALTERNATIVE

The central feature of the divestiture alternative is the creation of five independent general purpose digital computer manufacturers from existing IBM product lines and facilities. Accompanying such a horizontal divestiture are interrelated proposals and divestitures regarding IBM's activities in other than the computer markets and measures proscribing IBM's anti-competitive practices.

A. Computer manufacturing

This section first describes the plan for computer manufacturing and then evaluates its feasibility, its effect on competition, the possible costs to the economy in terms of economies of scale and its fairness to stockholders, executives and employees.

1. The divestiture plan

(*a*) *Main Frame Manufacture and Computer System Integration and Assembly* is the starting point for horizontal divestiture.[1] IBM operations at this stage are at several plants, each concerned with only one segment of the IBM product line. This organization of operations and facilities provides the basis for the creation of the following seven independent computer manufacturers, presumably by stock distribution to present IBM shareholders:

[1] Part (b) considers IBM's peripheral products. "Main frames" are used as the initial building block since they tend to "define" the system and since the required assembly and pre-installation testing of systems tends to occur at the site of main frame manufacture.

(1) *The System Three Corporation* would be allocated the smallest computers—IBM's System 3. This corporation would also be assigned IBM's tabulating equipment operation. The central facility of this new company would be IBM's Rochester, Minnesota plant which makes tabulating equipment and plants in Georgia and Florida which have been involved in the development and manufacture of System 3.

(2) *The Small Scale and Process Control Computer Manufacturing Company* would be allocated the manufacture of the 360/20, the 1130 and the 1800. Its major facilities would be IBM's Boca Ratan, Florida, and San Jose, California, plants, which now manufacture these three computers.

(3) *The Smaller Scale/Medium Size Computing Company* would have the 360/25 and the 360/30. It would receive IBM's Endicott, N.Y., plant which is the main frame manufacturing and systems assembly facility for these two systems.

(4) *The Medium Size Computing Company* would be allocated the 360/40, 360/44, and the 360/50. Main frame manufacturing and assembly of these systems would occur at IBM's Poughkeepsie, N.Y., plant, which is now engaged in these activties.

(5) *The Large Scale Computing Company* would have the 360/65, 360/67, 360/75, 360/85, and the 360/195 (still under development), whose system assembly and main frame manufacturing facilities are at Kingston, N.Y. The company would, accordingly, receive these IBM facilities.

(6) *The Federal Systems Company* would be IBM's present division of the same name. The division makes special purpose computers, largely for government use, at Owego, New York, and other locations.

(7) *The Terminals Company* would make IBM computer and operator communication terminals, such as the 1050 and 1060. Although these are arguably "peripheral products", a separate company is advisable here because terminals are expected to represent a large portion of the dollar value of systems and are the fastest growing portion of the computer market. IBM presently assembles its principal terminals at Raleigh, North Carolina, and this IBM plant would be assigned to this company.

The divestiture plan meets the obvious criteria of practicality: no existing product or plant is divided among firms. Of course, by breaking up one or more existing plants, as advocated by the Justice Department in its brief concerning relief in the *United Shoe* case, many additional divestiture alternative emerge. Under the foregoing plan, however, each company would be allocated at least one large former IBM plant (over 5000 employees) which is now the manufacturing center for its main frame and an assembly point for its systems. The obvious economies of scale of manufacture—those at the plant level—are thus preserved.

Computers are, of course, more than main frames. Indicated below are the complementary proposals for peripherals, components, marketing and service, software, and development.

(*b*) *Peripherals* are used across IBM's existing computer line and their manufacture is sometimes co-located with the assembly of certain computer systems. Such co-located units would go to the computer main frame manufacturer which is assigned the plant. Other peripheral plants would be distributed among the computer manufacturers in such a way as to equalize the potential revenues of the successor computer companies. Of course, some caution would have to be exercised in assigning peripheral capabilities because there is a large difference in the dollar value and market among various particular peripheral devices.

Since no single successor computer manfacturer would have a full peripheral line, they would necessarily engage in selling to one another and each would be partially dependent on purchased peripherals. In this respect, they would not differ from the present non-IBM companies.

The successor companies would be required to offer their peripherals to other computer manufacturers on equivalent terms. This provision would help the growth of the non-IBM computer companies, who now cannot obtain IBM equipment for integration into their systems at other than a "retail" price. Over time, one would expect that the seven companies would buy peripheral equipment from other than IBM successors.

The effect of these steps would be to open up IBM's closed preserve on its peripherals. IBM peripherals would become more freely available for the systems of other manufacturers and conversely the demand of IBM successor computer companies for peripherals would become open to independent peripheral manufacturers.

(c) *Components* are the even more elemental parts of a computer, including the individual circuits, wire contact relays, switches and the like. The IBM computers use many components in common and the manufacture of these items is now grouped in a separate division. It is proposed that IBM's component division become a separate company, selling to the seven IBM successor computer companies. As with peripherals, the new components company would also sell to the general market and other components vendors, such as Texas Instruments, would be free to sell to the successor computer manufacturers. One would expect then, a three-fold gain for competition. Components manufacture would have a major new competitor. Other computer manufacturers would have access to IBM components. Other component vendors would have available a new source of demand in the successor computer companies.

(d) *Marketing, Service, Software, Maintenance and Leasing* divides into two parts: that associated directly with the products of the successor computer companies and that less clearly identified with these companies. A new entity would be created to take over all these operations which entity would promptly turn over all outstanding leases of equipment still in production to the successor computer companies manufacturing such equipment. This would assure a flow of cash to each company from the outset. Each new computer company would thenceforth assume responsibility for maintenance, the basic associated software, and future marketing of their respective machines by hiring away from the new entity the staff formerly engaged in these operations.

The new entity would then be left with office buildings, perhaps a residual marketing staff, some pre-existing applications software, and responsibility for the continued leasing and maintenance of IBM computers no longer in production. It would have substantial revenues from out of production IBM computers. It could continue as a leasing, maintenance and software company, but to ensure that it did not dominate a new service or market, the new entity would be precluded from acquiring and leasing new computers. As the old machines were retired or sold, the assets could be liquidated and the cash distributed to stockholders.

(e) *Development* covers the design of new computers and is, of course, important to survival in the computer industry. There is a tendency, promoted by IBM publications, to think of IBM as one massive development entity. In fact, however, such key efforts as the design of the System 360 line was done by several teams at different locations and IBM has its present R & D activity located at at least 24 separate laboratories. One—Manassas, Va.—serves the components division and would be allocated to the new components company. At each of the principal plant locations for the seven computing companies there are major development groups, as follows:

(1) Mini-computers—Rochester, Minn.;
(2) Small computers—San Jose, Calif.;
(3) Smaller scale/medium scale computers—Endicott, N.Y., two labs;
(4) Medium scale computers—Poughkeepsie, N.Y., three labs;
(5) Larger scale companies—Kingston, N.Y.;
(6) Federal Systems—Oswego, N.Y.; and
(7) Terminals—Raleigh, N.C.

The development groups are concerned primarily with the products of the plants near them, so that there would be a natural fit in these assignments. There would remain a few other laboratories that serve a broader corporate function—such as the Thomas J. Watson Laboratory concerned with basic research. These might either be allocated to those companies so as to equalize assets and technical manpower of successor companies or, preferably, transfer of such laboratories to some sort of independent research foundation could be encouraged.

2. The divestiture plan results in economically strong companies

The survey above, operation by operation, indicates that each successor company retains a feasible set of activities appropriate for an independent company. Focusing on these eight companies as a whole, each would still be absolutely large. Their annual revenue is hard to predict from published IBM data, but the average would be well in excess of 500 million dollars. Another measure of size is the relative market share in the general purpose digital computer market, which would average for these companies about 14 percent. (IBM's present share of 70 percent would thus be divided approximately five ways—Federal Systems and Components are not in that market). While this would be a sharp drop, the 14 percent would still be twice the market share of the largest non-IBM company.

Furthermore, the companies would start with substantial financial assets in their share of a multi-billion dollar lease base. (Any sharp inequality in the division of the lease base could be equalized by the differential division of IBM's working capital.)

The resulting companies would, of course, be much less vertically integrated than the present IBM. But, as indicated above, the degree of vertical integration would remain comparable to that of other computer manufacturers. There might be particular facilities imbalances and the management of particular successor companies might regard some greater degree of vertical integration as desirable. But such shifts are relatively easy. IBM now spends about $400 million annually on plant and equipment and such a flow of investment funds would be divided among the successor companies for new investment. The high rate of growth of computer sales—over the ten years from 1959 to 1969 the market growth averaged over twenty percent annually—further enhances the opportunity of the new companies to alter their product lines. In addition, existing computer manufacturing plants are relatively adaptable to different kinds of manufacture. The major capital items in computer manufacture (except for components) are floor space and easily movable test and assembly equipment. Plants can be readily adapted to different products.

Although the new companies initially will have a limited computer line, the fact that they would be compatible would be an initial benefit to the U.S. national defense posture in that compatible computers would be available from multiple sources. In addition, over time, the successor companies could diversify into wider product lines if they so choose and, in so doing, have the financial advantages and manufacturing flexibility described above for vertical integration. In sum, the successor companies should not only be financially viable but economic successes. Each starts with an established product, proven in the market place and with facilities for its manufacture. Each will have access to IBM's present peripherals and components, together with the opportunity to buy such items on the outside market. Each will have the financial security from a big lease base. Each will have a development group and the financial resources to extend its product line horizontally and vertically. Each will have a substantial fraction of IBM's extensive marketing and maintenance force.

3. The divestiture plan represents a significant step forward in achieving effective competition

The plan would still leave IBM products as virtually dominant in separate computer sub-markets. This the successor computing company would have initially the same market share as IBM in a particular product line submarket. While high market share in a particular product is a significant source of IBM's market power, IBM's dominance is intensified by the compounding of market power through its position in all the various submarkets and combining such positions with (1) massive financial resources from a huge lease-base; (2) a marketing force that blankets the data processing field; (3) a complete product line so that customers with changing data needs will continue to be linked to IBM; and (4) a commanding position across product lines as well as with peripherals so that IBM can largely dictate the nature of technological change to its own advantage.

The divestiture plan strikes at these four sources of market power, even though it fails initially to modify the fifth—large share in a specific submarket. Financial power will be reduced because the successor computer companies will no longer be able to concentrate the massive flow of funds from the lease base on the development and marketing of certain product lines. The marketing force will no longer be ten-to-fifteen-fold the size of competitors and blanket every potential customer. And this marketing force will no longer be able to direct each customer, as his data processing needs expand, from one IBM product to another. Rather, in such situations the customer will evaluate on their merits the products of new independent IBM successor companies relative to those of competitors.

The adverse impact of IBM's monopoly power upon technological change and innovation will be dissipated. With several successor companies, it will be no longer possible for a single firm to paralyze the pace of change in the computer industry by announcements of proposed sweeping product changes or impose its standards on the entire computer manufacturing and user community. Alternative possibilities for procurement will serve both the immediate and long term national interest. To be sure, compatibility is important but absent IBM's

massive size, one would expect the initiative for change would be more widely distributed—both among successor companies and other computer manufacturers. Various companies would announce changes and those that met the market test as substantial progress and were followed by competitors and widely accepted by users would become the industry norm. Such a freeing up of technological change would yield a more desirable rate of technological change simply because it would be market tested, rather than the fiat of one organization.

Finally, the divestiture plan does offer the possibility for correction of the dominance by successor companies in particular submarkets. As indicated earlier, it is likely that successor companies will broaden their product lines and so compete with one another. The availability of former IBM peripherals and components to newcomers and other computer manufacturers on equal terms with IBM successors will encourage the rise of additional competition. The removal of the advantages of IBM's massive *overall* size and extensive product line will enable the present competitors of IBM to compete more effectively in each submarket, resulting in an increased market position of competitors.

4. The divestiture plan does not entail significant long-run losses in economic efficiency

In evaluating the divestiture plan, it is important to distinguish between "social" and "private" losses resulting from the removal of IBM's massive scale. Social economies of scale are true gains for the economy as a whole; private economies of scale are those accruing to the benefit of a single firm and not to the economy. Public policy is concerned only with social economies. And the divestiture plan involves relatively little loss in social economies.

As indicated above, the divestiture plan does not divide either individual plants or products. Hence the only conceivable source of the loss of economies of scale are those operations that encompass several products and plans; namely, financing, the use of common products such as peripherals and components, marketing, providing associated customer services, and development of new products.

The massing of financial power is one example of a private economy of scale. It is an advantage to IBM because it permits them to concentrate development expenditures on certain products and gain a competitive edge. It is not an advantage to the economy because the competitive edge for one company does not necessarily speed up technological progress for the economy. Rather there is considerable evidence suggesting that IBM, while massive in its resources, has not been the technological leader in computer development. IBM competitors, with a lower level of spending, have made many important contributions to the industry's progress.

IBM's vertical integration into peripherals and components again appears to be primarily a private economy of scale. IBM has a private advantage in that its extensive line of peripherals are unavailable to other computer manufacturers, except at the retail price. Yet since these terms restrict sharply the use of IBM peripherals by other computer manufacturers, IBM's private gain is a social loss. Since any true scale economies operable with respect to a particular peripheral product would remain intact, the future availability of each such product to all computer companies could thus well convert IBM's private economy to a social economy. Moreover, given the size and growth of the present computer market, there is evidence to suggest that any true scale economies are maximized at levels far below IBM's current production. The same situation is applicable with respect to components.

An extensive marketing service is again a private economy of scale for IBM, giving them a competitive edge. Whether or not one massive marketing service for a complete computer line takes less real resources in terms of manpower than several separate sales forces for the successor companies, and so becomes a social economy, is uncertain. The difference, however, cannot be very great, since the computer is not a repeat item sold in considerable volume but instead, each procurement must be individually tailored and marketed. Moreover, such manpower economies as may exist with respect to "repeat" customers, due to customer loyalty or the exploitation of other competitive advantages resulting from having a machine "on the inside", would—to the extent worthy of consideration—be preserved and reflected in favor of any previously "successful" vendor regardless of its size.

Maintenance and basic associated software are perhaps even less clear a case of minimal economies of scale. These services are now oragnized by IBM in teams specializing in various computers and so the economies of size are limited to such relatively minor items as common office space. Much applications software can be used by several computers but this work is now carried on by independent software companies and the plan leaves IBM's existing application software in the residual marketing company. Also much of the application software is now available as a separate product as the result of the "unbundling" of computer pricing.

Development is similarly unlikely to reflect significant social economies of scale. As indicated above, IBM's development groups for specific computers and for components are geographically separated and function in large part as separate teams. Moreover, the fact that other computer manufacturers with less extensive development groups have been able to keep pace and sometimes lead IBM's technological progress proves feasibility and suggests that the efficiency difference between very large scale and more modest scale development efforts is not a decisive one for the rate of technical progress. Finally, due in part to its large lease base, IBM has tended to defer announcement of new products until forced to do so by competition or to maintain a "desired" growth rate, thereby denying to seciety such benefits as could even theoretically derive from massive development efforts.

5. The plan is equitable to IBM's stockholders, executives and employees

Although the Supreme Court has recognized the minimal consideration to be given "private interests" in framing effective remedies to redress antitrust violations, *U.S.* v. *duPont*, 366 U.S. 316, the instant divestiture alternative is fair to the interests of such parties. The IBM stockholders will receive stock in all the successor companies in exchange for their present IBM holdings. In aggregate, the same financial and physical assets will be represented by the new stock. Stock in IBM, as opposed to that in successor companies, does provide the financial security of diversification by reflecting wide product line and a wide range of "data processing" activities. Yet stockholders that continue to want such diversification can leave their holdings distributed among successor companies. Those that wish to concentrate on particular activities can rearrange their portfolio to do so. IBM stockholders can thus select varying mixes of activities if they so wish and, in addition, will be able to select as well as invest in different managements of the various successor companies.

Against this gain must be set a loss in the portion of the value of IBM stock representing monopoly profits. This is an inevitable cost of a public policy directed at eliminating monopolization. Yet in the high growth computer industry such losses should be modest and transitional. While it is obviously foolhardy to predict the course of post-divestiture stock values, the risks seem less than in other major divestitures

As for IBM executives, divestiture will convert many IBM divisional executives now serving as second or third level management into top management since there will be eight top management groups rather than one. The executive losers from divestiture will be confined primarily to the small group of top executives who will forfeit the power and prerogatives of administering one of the world's largest private enterprises.

The successor companies would assume all the obligations of the pension plans and benefits of the executives and employees in facilities they are assigned. The special leasing company described above will assume a corresponding obligation for branch and central office employees who are not hired by the successor computer or components companies. This company will have both the extensive office buildings owned by IBM throughout the country and the leases on older computers as assets with which to meet obligations to these employees.

To sum up, the divestiture should preserve much of the significant equities of IBM stockholders, executives and employees.

B. Divestitures in related markets

The preceding measures are directed at the general purpose computer market. There remain other components of IBM that should also be divested to IBM stockholders on the grounds that: (1) They can be economically viable companies in their own right; (2) assigning any one to a particular successor computer company would make successor companies unequal in size; and (3) the particular operations are so large in their respective markets and so closely

related to the marketing of computers that ownership by such a computer company jeopardizes competition in the computer market.

Four IBM operations particularly fit these conditions: The Service Bureau Corporation (SBC), the Office Product Division, Science Research Associates, and the World Trade Corporation.

1. The divestiture of SBC

Under the 1956 Consent Decree, SBC is supposed to be operated as an arms-length corporation. Yet there is considerable evidence that its computing services promote IBM's computer business through "customer captivity" as well as through offering IBM opportunities to institute price discrimination through the free usage of computer time, free manpower or software support, and buy-backs of computer time. Furthermore, it provides a sheltered market for IBM equipment. As a result, SBC is another source of IBM market power in the computer business.

The divestiture of SBC, through a stock distribution, would prevent this source of market power in the computer market from being utilized by any successor computer company.

2. The divestiture of the Office Product Division

IBM's Office Products operations are organized as a separate division, with its own plants, development group, and executive organization and with revenues in the hundreds of millions of dollars. The principal product of this division is office typewriters in which IBM has a substantial market share. In addition, IBM recently announced entry into the office copier market. This division should have no difficulty operating as a separate company. While at present the interrelationships between office products and computers are not extensive, the coupling of magnetic tape to typewriters and copiers could give a computer manufacturer with a large share of outstanding office typewriters and an entry in the copier market a powerful position in the computer market. Accordingly it is proposed that the Office Product Division be divested into one, or perhaps two, separate companies.

3. The divestiture of Science Research Associates (SRA)

SRA is a recent IBM acquisititon which develops and markets computer applications in the educational area. It is an asset in the marketing of computers which should not be assigned to any one particular successor company. Since SRA has previously been successful as a separate company it can be easily re-established in this status.

4. The Divestiture of the World Trade Corp.

IBM has concentrated its foreign operations in a single subsidiary—IBM World Trade Corporation. This subsidiary can be a separate company for it already has its own overseas marketing force, extensive manufacturing and development activities, and a distinct set of executives. As a separate company, it would have over a billion dollars in annual revenues.

As a separate company, however, at least initially World Trade would have to buy the many products it does not manufacture from successor companies in order to offer a complete data processing line. And it is likely to need to license technological know-how from successor companies to stay abreast of changing technology. But these relationships would have a somewhat lesser impact on domestic competition than the existing ones.

The impact of a dominant position in many markets abroad would be diffused among several successor computing companies. At the same time, the impact on American trade from divestiture would be minimal since World Trade in effect now buys from IBM's domestic operations. Over the longer run, World Trade could buy from other American computer manufacturers if their products proved superior. Thus World Trade's commanding position in various foreign markets might become available to other American computer manufacturers.

C. Anti-competitive practices

Since the divestiture recommendations are fairly comprehensive, the scope of injunctive relief can be limited to a few key items. Nonetheless, since the IBM successors will have, at least initially, very substantial market shares in particular computer submarkets, four major provisions are required: limitations on price discrimination, limitations against paper machines and the like; requirements on product disclosure, and provision for royalty-free licensing.

1. Pricing

Price discrimination is a traditional tactic of a dominant firm to gain and to maintain market power—cutting prices for a group of customers or with respect to products where competition is vigorous while maintaining high prices elsewhere. IBM has made extensive use of price discrimination. Given IBM's record, the importance of price discrimination as a source of market power, and high market shares in many computer lines even after divestiture, injunctive provisions are required to eliminate price discrimination.

Price discrimination can be eliminated by requiring IBM to institute "auto sticker pricing". Such pricing would have the following features:

(*a*) Each successor company and WTC would be required to publish a separate list price, together with terms of sale such as credit, trade-in allowances, etc., for (i) each unit of the computer, (ii) software (such as each compiler, assembler, application, and special user program), (iii) maintenance services, (iv) programming services, (v) customer training, (vi) other products or services related to the sale and support of computers. This would make mandatory the present practice of "unbundled" prices.

(*b*) All sales (except competitive bids to a government agency) must be at the list or "sticker" price and at published terms except as justified to meet competition. Each product or service priced seperately must be available for purchase separately and profit margins on different products or services must be reasonably similar. Such provisions would restrain price discrimination directly by requiring uniform prices to different buyers, prevent any single item from being tied to another (often hiding price discrimination), and prevent any item from being offered at a low profit margin. It would eliminate the educational discount.

(*c*) All sales offers, bids and proposals would be made in writing containing the above prices, delivery date, and other terms and conditions, and the customer would be allowed 30 days to accept or reject the proposal or any part of it. Orders would be filled in the order of their receipt. This would prevent hidden price discrimination via oral agreements, prevent the practice of stampeding a customer into accepting an order, as well as prevent discrimination between customers via delivery dates.

(*d*) To prevent subtle forms of price discrimination, grants to a customer or participation in joint ventures or projects to induce a purchase of a computer or related service would also be prohibited.

2. Paper machines, programs and the like

This practice can be reached by a provision prohibiting successor computer companies and WTC from offering, advertising or otherwise disclosing to the trade any computers, programs, or related equipment prior to an operational demonstration of such item. These demonstrations are to be open to competitors and the public and the operational characteristics demonstrated must conform to the advertised specifications, which specifications must themselves contain sufficient detail as to be meaningful. Such demonstration shall not be held prior to the time the products or services are ready for manufacture and distribution in production quantities, thus insuring quotation of realistic delivery schedules.

3. Product standards and compatibility

One advantage of IBM's vast market share is that by its dominance it creates certain standards on a de facto basis to which its competitors must conform, thus raising difficulties for other manufacturers in making their equipment compatible with that of IBM. While dividing IBM's product line among several companies reduces the scope of the problem, the dominance of successor companies in particular markets still leaves a potential threat to competition from sharp changes in product standards by the firm with the dominant market share. Without prior notice, competitors would be placed at a substantial disadvantage. Accordingly, with respect to all new or proposed products or software which have characteristics which will affect information interchange or interface between a successor company's or WTC's systems and competitive systems, such companies and WTC should be required to disclose confidentially to every U.S. computer manufacturer complete functional specifications of all such new products and software and of each major change in existing products and software 24 months prior to their first delivery. The particular standards which require disclosure relate to devices utilized for information interchange in general and particularly those that involve interchangeable media. Some mechanism would have to be devised to prevent the abuse of this requirement by disclosing new standards which subsequently are not actively marketed.

4. Royalty-free patents

IBM and WTC now have thousands of U.S. and foreign patents and patent rights, relating to computers which consitute one source of its market power. To give the portfolio to any one successor manufacturer would give that company a major edge over others and provide the basis for new positions of market power. To divide the portfolio would necessarily require extensive patent cross licensing between competing companies. The simplest solution would be to establish royalty-free licensing of all IBM's present patents.

Such royalty-free licensing should be extended to all domestic computer manufacturers so that this limitation on the growth of competitors would be eliminated. New discoveries of succesor companies would, of course, be patentable so that there would be no lack of incentive for research and development.

II. MARKET SHARE LIMITATION

An alternative to horizontal divestiture is the *gradual* reduction of IBM's substantial market share—the source of its market power. The reduction in market share is achieved largely through proscription of certain practices that now maintain IBM's market share. Described below is an illustration of this approach in the general digital computer market. The accompanying prohibitions on anti-competitive behavior as well as divestiture of certain activities outside the computer manufacturing market are integral parts of this proposal.

A. The general purpose digital computer market

1. The general concept

If IBM would grow at a slower rate than the market (though faster than most large corporations) then its market share could fall substantially and existing competitors could grow relative to IBM. As a result the market share disparity between IBM and its competitors would substantially narrow. The anti-competitive character of the computer market is this size disparity rather than too few competitors.

The effects of such market share limitations can be illustrated by one feasible set of assumptions as follows:

(*a*) Assume that the market for computers grows at 20 percent annually. This is a somewhat lower rate of growth than was experienced in the overall computer systems market during the sixties, but a conservative projection would allow some decline from the very fast growth rates of the sixties.

(*b*) Assume that other computer manufacturers grow at an annual rate of between 23 and 27 percent. They were able to sustain such a rate of growth in the sixties and except for financial limitations and IBM dominance could probably have exceeded it.

(*c*) Assume that IBM's growth is limited to 90 percent of the rate of overall market growth in the early years (to preclude requiring a very high rate of growth by competitors) and gradually falls to seventy percent of the annual market growth rate.

Under these assumptions, IBM's market share would be about 45 percent over ten years and about 30 percent after twenty years. Thus, after twenty years, it is probably that IBM would be about twice as big as its larger competitors rather than the present ten-fold difference.

These are simply illustrative assumptions. IBM's market share, for example, could be brought down sooner by a greater reduction in its relative growth. The following discussion, however, continues this particular illustration.

2. Implementation

A mechanism for bringing down IBM's market share can be illustrated by the following provisions:

(*a*) The market would be measured by the incremental dollar value of domestic and foreign shipments of general purpose digital computers and the data would be collected by an annual survey by the Department of Justice. The survey should also include special purpose computers and if special purpose computer sales grow at a significantly faster rate than general purpose digital computer sales, the market share provision would apply to both types of computers.

(*b*) In any two-year interval that IBM's growth exceeded the target, 1(c) supra, IBM would be prohibited during the next two-year period from (a) expanding its manufacturing capacity for general purpose digital computers, (b) adding to its number of salesmen, system engineers, or any other personnel who sell or assist customers with new installations or (c) increasing its expenditures

in the marketing of computers. This provision would create an incentive for IBM to maintain a steady, but more modest, growth to bring down its market share.

(*c*) The reduction in market share would be facilitated by the provisions enumerated in the next section. The market share limitation is in the nature of a "fail safe" provision to make sure IBM's market share falls.

(*d*) If at the end of twenty years IBM's market share has not fallen to 35 percent, divestiture would be required. This provides further incentive for IBM to cooperate with a reduction in its market share.

B. Prohibition on practices and divestiture of related activities

Given the fact that market share limitations rely on competitive forces to bring down IBM's market share, more extensive proscription of anti-competitive practices are required than with divestiture. As a starting point, the previous restrictions with respect to price discrimination, paper machines, product compatibility and royalty free licenses of existing IBM patents should be included in the market share limitation. The divestiture of SBC, SRA and the World Trade Corporation should also be included and perhaps the Office Product Division as well, though the operations of this division are less clearly related to market power in the computer market.

In addition, all of the exclusionary practices alleged in the U.S. complaint, and those of the private plaintiffs, must be prohibited or otherwise arrested. Such provisions would include prohibitions against corporate interlocks, reciprocity, tying, and other such practices. Other examples include:

1. Proscription on IBM future leasing of equipment

Leasing has long been recognized as a source of market power in such industries as shoe machinery. Eighty to ninety percent of IBM's computers are leased. Such leases are a major source of IBM's market power since they provide for a continuing relationship between IBM and its customer. Much of IBM's price discrimination and many of its unfair practices are related to leasing.

It would perhaps be too disruptive to require IBM to sell all its existing leases. (In the divestiture plan, a separate leasing company was established, but only as part of a general design for a reorganized industry). As a substitute IBM should be prohibited from engaging in the leasing of any new computer installations although it could renew existing leases. Time payment plans or other lease "substitutes" would also be prohibited. Such an outright prohibition would strike at many of the unfair competitive tactics associated with leasing by a dominant firm.

To be sure, it is sometimes argued that leasing as a source of market power can be handled in a less drastic fashion. Thus, the particular practices associated with leasing may be enjoined and coupled with a requirement that the defendant maintain neutrality between sales prices and lease rents so that outright purchasing no longer carries a penalty. But this provision has often proved difficult to administer—just how is neutrality to be defined? Moreover, leasing can be favored in all sorts of nonprice ways. Another possibility is a new Leasing Corporation, a wholly-owned IBM subsidiary which must, like the Service Bureau, be operated on an arms-length basis. But the history of the Service Bureau shows the extreme difficulty of achieving true arms-length arrangements with a wholly-owned subsidiary.

Prospective prohibition of leasing by IBM would be a simple and effective way of taking them out of the leasing business. The users would not suffer since leasing corporations stand ready to fill the gap. And users that prefer to lease from a manufacturer could do so from other manufacturers. Over the long-run, breaking the tie between IBM and its lease customers would help the growth of IBM's rivals.

2. The prohibition of IBM operation of data processing centers

The advantages of divesting SBC were indicated earlier. Similar arguments support the prohibition of IBM's operation of data processing centers which use IBM equipment, although the 1956 Consent Decree provisions could be "satisfied" in this respect. A firm selling both to itself and others has extensive opportunities for price discrimination in favor of its own operations, when it has a predominant market share. Vertical integration into data processing would reserve part of the computer market for IBM when the critical requirement is for bringing down IBM's market share.

3. The operation of Federal System Division as a separate corporation

The divestiture plan (Part I) provides that the Federal Systems Division be established as a separate company. If pursuant to market share limitation, it were decided that this division remain a part of IBM, other measures would be necessary to insure that competition is not jeopardized.

While most of the division's activities are not a central factor in the general purpose digital computer market, they help IBM to maintain market power in that "know-how" resulting from this division's research and development, financed by the government, assists and complements IBM's commercial research and development efforts. In addition, hardware compatibilities, customer contracts and other knowledge concerning the government's broader requirements all of which are developed pursuant to such special projects, can be, and often are, used to assist and justify additional sales of general purposes equipment to government agencies.

To minimize these problems, IBM should be required to establish the Federal Systems Division as a separate corporate subsidiary, operated at arm's length and required to report profits separately. The new corporation would be prohibited from any marketing activities intended to promote the sale of IBM commercial equipment. Moreover, to the extent national security will allow, both the plans and results of its research and development activities would be made available to other domestic computer manufacturers at the same time it becomes available to IBM divisions engaged in commercial activities.

4. The licensing of IBM patents at reasonable royalties

As indicated above, IBM would be required to license its existing patents on a royalty-free basis. While IBM is by no means the technological leader in data processing, its massive research effort can be expected to generate at least occasional key patents, which might preclude the growth of competitors. Accordingly, IBM should be required to make available to domestic competitors any future U.S. and foreign patents on a reasonable royalty basis.

Finally, as above noted, other provisions designed to arrest other of IBM's activities as alleged in the various complaints against it would also be necessary to insure the success of market share limitation.

C. The evaluation of market limitation

As with divestiture, this kind of structural relief can be evaluated both in terms of its contribution to effective competition and its effect on IBM stockholders, executives and employees. Since this form of relief does not entail significant changes in the present size of IBM, the questions about economies of scale are not critical.

1. The impact of market share limitation on competition

An advantage of market share limitation is that it encourages the growth of IBM's present rivals. It thus recognizes that the crucial problem of the computer industry is not necessarily too few competitors but IBM's market share—ten-fold greater than its largest competitor.

The disadvantage is that the structural change in the industry is postponed for many years so that there may be delay in the arrival of effective competition. In the interim the court must retain jurisdiction in order to police the injunction. The major drawback, however, could be the possibility that IBM's competitive drive might be handicapped by a market share limitation. The word possibility is stressed because the market share limitation may, in fact, not be operative. With IBM's present anticompetitive practices prohibited, IBM, in the new competitive market, may be forced to compete vigorously, simply to prevent a greater fall or decline in its market share than the market share limitation requires. Hence the market share limitation provision is only a contingent provision operative only if the new more pro-competitive rules for IBM fail to generate a decline in market share.

2. The effect of market share limitations on IBM stockholders, executives, and employees

Although IBM stock values reflect anticipated future growth (as well as monopoly profits), market share limitation by no means drastically jeopardize IBM's growth prospects. With respect to the computer industry, in light of the history of rapid growth, even during the plans most restrictive years it is likely that IBM could still grow over twice the rate of the Gross National Product which by definition is the average growth of all economic activity. The restriction thus

does not preclude IBM from growing, and growing faster than most corporations. Moreover, more modest growth in the computer industry would mean a lesser drain on IBM's cash flows for expansion so that IBM could pay higher dividends or channel its growth into other industries—like copiers. As a result, the effect of a growth restriction in the computer market upon IBM stockholders and executives would be mitigated—while competition in other industries would be encouraged.

III. CONCLUSION

Each plan promises effective structural relief which would enhance competition and thereby promote the public interest in a strong computer industry without jeopardizing the national security. Each protects the ability of IBM to prosper, to innovate and to contribute to a competition computer industry. Determination of which of the two is better public policy turns in large part on the importance given to achieving immediate structural change, without continued supervision. In any event, each plan demonstrates that effective competition can be achieved without significant social costs of the economy.

Exhibit 4.—*Memorandum re restoring competition in the industry*

MEMORANDUM OF CONTROL DATA CORPORATION RE MEASURES TO RESTORE COMPETITION IN THE COMPUTER INDUSTRY AND FOSTER COMPETITION IN THE COMPUTER RELATED INDUSTRIES

September 22, 1972.

Since the filing of Control Data's suit against IBM in December of 1968, and the filing of the government's case against IBM four weeks later, Control Data devoted considerable thought to the question of what kinds of relief against IBM are necessary to restore competition and are at the same time feasible. Dismemberment of IBM along product and divisional lines has been seriously considered.* However, an alternative to extensive divestiture may be deemed desirable to minimize the risk of adversely affecting the U.S. position of dominance in the computer markets and to minimize the possibility of turmoil that some may think would result from the dismemberment of IBM into sufficiently small entities to dissipate IBM's market power.

The following relief measures would lessen IBM's monopoly power in the general purpose computer market, by a combination of structural relief and injunctions prohibiting IBM's monopolistic practices in that market. Additionally, the suggested measures would immediately insulate, and thereby avoid IBM potential dominance of, the related markets of data services, professional services, and remote terminals.

THE PRESSING NEED FOR RELIEF

The record of the antitrust litigation demonstrates the pervasive character of IBM's monopoly power and the necessity for early and substantial relief. On November 1, 1971, Control Data submitted its Preliminary Pre-Trial Memorandum to the District Court in St. Paul and furnished a copy (minus documents asserted by IBM to be privileged) to the Department of Justice. The principal evidentiary source for this four-volume memorandum is IBM documents. Control Data's memorandum contains convincing proof of IBM's possession and direct use of monopoly power, as well as proof of the nature and deleterious effect of IBM's anti-competitive practices.

Control Data's case is being aggressively prosecuted toward trial. However, an "early" and successfully concluded trial in Control Data's case may not provide adequate relief, because the courts are understandably reluctant to grant structural relief in private cases. While the courts have the power to grant such relief to private parties, this reluctance would probably be even stronger in

*On September 1, 1970, Control Data submitted to the Antitrust Division of the Department of Justice a paper entitled "Achieving Effective Competition in the Computer Industry". In that paper, we discussed our views as to the relief measures required to end the monopolization by IBM of the general purpose computer market. The emphasis in that submission was on the feasibility of a 13-part dismemberment of IBM, as well as injunctions to prohibit certain anti-competitive market practices. That paper also mentioned the possibility of a relief measure which would require IBM to reduce its market share over time.

cases where, as here, a government suit against the same defendant—for basically the same offense—is pending. So the active prosecution of Control Data's action in no way detracts from the need, felt by both Control Data and the industry (and, indeed, the country), for timely structural relief in the government's case.

The importance of early and stringent relief dissipating IBM's monopoly power is no longer debatable. The withdrawal from the general purpose computer market of GE and RCA, two of America's largest companies, is dramatic evidence in and of itself. The "psychological" effect of those departures is still a factor. Not only has user confidence been shaken, but also many industry observers continue to question the viability of other main frame companies. The government's intention to curtail IBM's power—and thereby to strengthen competition—must be make known in specific and unmistakable terms.

We also recognize that critical problems of economic survival are being faced by the smaller firms in the peripheral equipment, software and services markets. Again, only early and meaningful relief can contribute to solving these problems.

THE RELIEF MEASURES PROPOSED

The measures proposed include a combination of structural relief, mandatory compatibility, and injunctive relief against specific exclusionary practices.* They are intended to recognize the distinct and yet interrelated character of the many markets or sub-industries that comprise the electronic data processing sector of the economy. It is important to recognize that the effectiveness of the proposed relief is dependent upon the implementation of the entire group of measures because of their interrelationship.

The suggested measures are:

Relief Aimed at Restructuring the Computer and Computer Related Markets

Divestiture of IBM's Components Division and prohibition of IBM from reentering the business of manufacturing semiconductors or other components.

Divorcement of IBM from the business of manufacturing and marketing remote terminals and communications-oriented equipment, including data preparation equipment applicable to remote terminals.

Divestiture of the Service Bureau Corporation (SBC) and divorcement of IBM from the data services and time-sharing businesses.

Divorcement of IBM from the business of providing professional services, and education/training (other than providing those services associated directly with its computer sales), and divestiture of Science Research Associates (SRA).

Divestiture of IBM's Office Products Division and divorcement of IBM from the type of business conducted by that Division.

Mandatory Injunction To Achieve Compatibility

Mandatory use by IBM of higher order languages, and mandatory disclosure of product specifications and design technology leading to hardware and software compatibility.

Injunctive Relief Against Specific Exclusionary Practices

Prohibitions again unfair and predatory pricing practices, including (a) bundling, (b) hidden discounts, (c) discriminatory pricing, and (d) "fighting machines".

Prohibition against marketing "paper machines".

These measures of structural and injunctive relief must be coupled with a suitable means of policing. To enhance its effectiveness, the court decree should contain provisions permitting IBM competitors and customers to bring enforcement actions.

IBM's persisting market dominance is founded in its monopolistic share of the general purpose computer market, certain IBM-induced structural characteristics of the computer business that particularly entrench and magnify a dominant market share, and IBM's exploitation of certain unfair market practices. IBM has created and buttressed its power with a set of "technological and market tie-ins" which enhance its ability to structure the market in ways to insulate its market position from competition.

In addition, IBM threatens to extend its domination of the computer market to the related markets of data services, professional services, education and

*The relief measures are described in this memorandum in terms of general concepts. The details of such measures would require a draft decree of considerable length.

remote terminals—all markets suited to effective competition among smaller companies.

THE PROPRIETY OF DIVORCEMENT RELIEF APPLICABLE TO RELATED MARKETS

Unless IBM's market power is checked, IBM will extend its domination of the computer hardware markets to these related markets. IBM's predominant share of the general purpose computer market provides a natural "springboard" which IBM can use to dominate the remote terminal market and data, professional and education services. IBM's familiarity with and ability to take advantage of such springboards is well documented:

1. In 1932, IBM (according to the government's complaint) had 85% of the tabulating *equipment* market and used its monopoly position in that market, as adjudicated by the court (298 U.S. 131), to restrain trade in (and, in effect, to monopolize) the related tabulating *card* market.

2. In 1952, the government again sued IBM for antitrust violations, this time directly attacking IBM's monopolization of the tabulating equipment market. The 1952 complaint, which expressly referred to the 1932 case, was settled by a consent decree in 1955. Although this 1952 complaint made no mention of computers, the prohibitions contained in the 1956 decree extended beyond tabulating equipment to the then related (and embroyonic) business consisting of the manufacturing and marketing of computers.

3. The third phase in this history of the government's attempt to prevent a sequential domination by IBM of these related markets was commenced with the institution in 1969 of the government's current Section 2 case against IBM. The 1969 complaint expressly refers to the 1952 case and, notwithstanding the fact that the 1956 consent decree purported to restrict IBM's activities in marketing computers, expressly alleges that IBM used its monopoly position in the tabulating equipment market as a springboard to monopolize the business of manufacturing and marketing general purpose computers.

What now must be obviated is the continuation of the current market environment which will lead to the filing—perhaps in the late '70's—of still another Department of Justice complaint against IBM, one which will charge IBM with monopolizing these hardware and service markets which are so closely related to the general purpose computer market alleged in the pending government case. This prospective complaint would be formidable, alluding as it would to IBM's dominance in tabulating equipment which was used as a springboard to IBM's monopolizing of the computer-marketing business, which monopoly, in turn, provided the springboard for IBM's monopolizing of these growing computer-related markets. But if the objective of Section 2 litigation is to obtain relief which is structural in nature and therefore lasting—thus avoiding the need for future complaints and litigation—then we submit that the time is now to divorce IBM from these related markets. "The very purpose of prophylactic structural relief is to obviate the need for new antitrust suits by foreclosing threatened violations before they can occur." (January, 1970 brief of the Department of Justice to the Supreme Court in the *Armour-General Host* case; p. 32)

This type of divorcement relief against a monopolist is clearly appropriate. Relief addressed to markets directly related to the markets which are the focus of the litigation—as was done in 1956 in the case of IBM itself—was one of the principal objectives obtained in the *Meat Packers* case (*U.S.* v. *Swift & Co.*, 276 U.S. 311). There, the complaint alleged dominance in meat-packing and *threatened* dominance in the non-meat food business. While divestiture of the defendant's meat-packing assets was not ordered, the decree divorced the defendants from the business of food distribution, the net effect of which relief was that the meat companies' ". . . economic power was thus not destroyed but rather hemmed in." (*U.S.* v. *Swift & Co.*, 189 F.Supp. 885 at 892, the 1960 modification proceeding).

The propriety—and necessity—of utilizing such divorcement remedies was documented by the government in its brief (pp. 30–32) to the Supreme Court in the related *Armour-General Host* case:

"Structural relief which restricts or eliminates a defendant's activities or financial interests in certain lines of commerce is an important instrument among the varied and flexible forms of remedy which have been decreed to prevent particular threats to competition. Such relief has been utilized in court orders in a variety of monopolization, merger and restraint of trade cases, most commonly to prohibit entry into certain lines of commerce by acquisition *and sometimes*—

as here—to exclude companies from any kind of involvement in the prohibited lines. . . . As substantive antitrust law dealing with monopolization and multi-line firms develops, relief which requires separation of defendant firms from certain markets will continue to be of importance to the reduction of excessive concentration in the economy." (emphasis added)

In light of the fact that the avoidance of market concentration and dominance is the central theme of Section 2 of the Sherman Act, the suggested containment of IBM is both necessary and fully warranted.*

PROPOSALS FOR STRUCTURAL RELIEF

I. Divestiture of IBM's Components Division, Combined with Injunctive Provisions Against IBM Resuming the Business of Manufacturing Components.

A. The Problem

Components are the elemental parts of a computer, such as wire contacts, relays, switches discrete semiconductors and, most important, integrated semiconductor circuits. IBM purchased most of its components, including semiconductors, until 1958 when it began the manufacture of its semiconductors. IBM now has the largest semiconductor manufacturing capability in the world, semiconductors being the major product of the IBM Components Division. IBM has seldom if ever made its semiconductors available to other computer manufacturers, and IBM purchases only a minimal proportion of its requirements for the more sophisticated semiconductors from outside vendors. Thus, IBM semiconductors are largely a closed preserve—with IBM neither buying nor selling the semiconductors critical to the manufacture of computers.

The importance of this kind of vertical integration has been intensified by a pattern of technological change in which more and more of semiconductors and their circuitry have been combined on a single chip, so that a single chip now performs major computer functions. Robert O. Wilson, manager of IBM's Systems Development Division is quoted as follows: "The keystone to ease of computer use is large memories and semiconductor technology gives us that." (Fortune, March, 1972, p. 149)

IBM has been able to manufacture semiconductor circuits at a unit cost that cannot be matched either by other computer manufacturers or semiconductor manufacturers. IBM's cost advantage arises from the very large scale of its semiconductor operation. Its competitors in the computer industry cannot match that scale in their own component manufacturing because their individual market shares in the computer industry are less than a tenth that of IBM. Control Data and other IBM competitors purchase most of their semiconductors from such companies as Texas Instruments, Fairchild and Motorola. None of these suppliers has volumes comparable to IBM's nor the ability to set standards in the more sophisticated semiconductor devices used almost exclusively in computers. Since IBM's own captive operations account for over 70 percent of the potential market, reflecting IBM's dominance of the computer industry, the potential volume of individual suppliers is necessarily limited. Thus, neither firms in the computer industry nor in the semiconductor industry have the capability of developing and manufacturing semiconductor circuits at a cost close to that of IBM. The resulting competitive disadvantage imposed on IBM's rivals in the computer industry, already critical, is likely to become even more acute as integrated semiconductor circuits become an even more important part of the cost of the computer main frame in the coming decade.

It is significant to point out that large scale integrated circuits (LSI) are now entering the state of development that allows their incorporation in new generations of computers. The economies of scale associated with mass production of the LSI circuits will provide both a technological and production economy to IBM that may foreclose other manufacturers from the computer manufacturing industry within a decade. Means must be found to allow all computer manufacturers to share in these economies of scale so as to provide the consumer with the benefits of mass production and effective competition.

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*The suggested relief addressed to the computer related markets is particularly beneficial because such markets are well served by smaller firms which can more effectively meet the diverse and changing needs of those growing markets than a corporate giant. This relief furthers the objectives outlined in the President's March 6, 1972 message to the Congress on "Science and Technology" by improving the climate for innovation and small high technology businesses.

B. The Suggested Relief

The solution lies in a divestiture of IBM's Components Division which contains its semiconductor development and manufacturing capability. The new unit would become a separate company able to sell to IBM but required to make its products available to the other computer manufacturers at prices corresponding to those charged IBM.

To prevent IBM from recreating this source of monopoly power, IBM should be prohibited from negotiating with any manufacturer for the purchase of proprietary circuits. It could, of course, participate in the development of such circuits with a semiconductor manufacturer, but such circuits should be available for sale to the other computer and semiconductor manufacturers. It should also be prohibited from negotiating special prices with any manufacturer for semiconductors. Finally, it should be barred from resuming semiconductor manufacture after the divestiture, either through acquisition or internal expansion or through importing components from foreign subsidiaries.

C. Evaluation

The divestiture proposed here is clearly feasible. IBM's Components Division already has a distinct divisional management, separate manufacturing plants, and its own research facilities.

Since the proposed divestiture does not change the size of IBM's present Components Division, there would be no loss in economics of scale in these operations. Nor is it likely that there would be significant loss in "coordination" economies between IBM's computer operations and its components needs. IBM could still sponsor the development of components with independent component companies, including the successor its Components Division. IBM would still have strong incentives to continue such development, given its massive size and the critical relationship between progress and economies of scale in components and computers. What IBM could not do is bar the benefits of such progress and economies of scale in semiconductors from its competitors in the computer industry. Finally, there need be no rise in profit margins. IBM now earns a return on its capital devoted to components—which return would represent the profits of the new company.

Progress in components would be available to the entire computer industry and others on an equal basis. One source of IBM's dominance in the general purpose computer market would be eliminated and its rivals would be more on a competitive parity. Additionally, this divestiture would open up IBM's vast semiconductor requirements to the companies like Texas Instruments, Motorola, and Fairchild, who could now compete to serve IBM. At the same time, these companies would have a major new competitor in the successor to IBM's Components Division. A vigorous independent U.S. semiconductor industry is, of course, a boon to the computer industry as well as an essential element in America's technological leadership at home and abroad.

II. Divorcement of IBM from the Business of Making and Selling Remote Terminals and Data Communications Equipment.

A. The Problem

Remote terminals and related software have special design features or architecture that permit use via communications facilities at locations considerably distant from the central processing unit. In addition, there are other types of equipment—such as modems, controllers and multiplexing units—that also are communications-oriented in their design. The divorcement provision would cover all equipments designed and manufactured for interconnection with communications facilities.

These various kinds of data communications equipment have a very high growth potential in the decade ahead. IBM may soon dominate the remote terminal and data communications equipment market. IBM already is a major factor in the mini-computer market, a major component of remote computing networks. It is also the major seller for many other types of data communications equipment. Of the main frame manufacturers, IBM alone has a full line of compatible computers combined with an extensive line of data communications equipment. IBM can connect mini-computers to its super-computers and its own data communications equipment to create a massive data processing network for a large customer including data processing service centers. Most elements of that system would be its own products. IBM then would be in a position to engage in activities that have the effect of "full-line forcing", a

classic monopoly tactic, thus locking out IBM's rivals in the general purpose computer market as well as the independent manufacturers of remote terminals, peripherals, and mini-computers. The support divorcement relief would accomplish both the prevention of the threatened domination by IBM of this "terminal" market and the curtailment of IBM's exclusionary power in the general-purpose computer market.

B. The Suggested Relief

IBM would be divorced from the business of manufacturing and marketing equipment designed for remote terminal usages, including all data communication equipment, such as terminals, modems, interfacing controllers and multiplexing units.

C. Evaluation

The proposed action presents no feasibility problems. IBM could readily devote its present manufacturing facilities for these products to technologically similar ones. The remote terminal market can be easily supplied by other manufacturers who already have established products and competence in these activities. These products also lend themselves to new entry by innovative smaller companies.

IBM central processing equipment would still be available for operation with terminals and data communication equipment purchased from other manufacturers. Competition among the various terminals manufacturers—both those now established and among smaller companies recently entering this business—will encourage the growth of this mode of computer operation which often results in savings to the users. Indeed, IBM will then have a major interest in the growth of the terminals business of other manufacturers and will be encouraged to work out usable interface standards. At the same time, one promising method whereby IBM could perpetuate its general purpose computer system dominance will be blocked.

III. Divestiture of Service Bureau Corporation and Divorcement of IBM from the Data Services Business.

A. The Problem

The 1956 consent decree implicity acknowledged that one source of IBM's monopoly power was its practice of starting a customer at an IBM service bureau for the purpose of familiarizing him with IBM computers and causing the preparation of his data on IBM media. IBM then used this exposure to, and reliance upon, its products and personnel to sell IBM equipment. Given IBM's dominant position, such practices placed its computer-manufacturing competitors at a substantial disadvantage. The 1956 consent decree required IBM to confine its service bureau business, *i.e.*, customer data handling and processing (including facilities management), to SBC, a wholly-owned subsidiary which was to be operated at arms-length and not to assist IBM's sales activity in computers.

The prescribed "independence" of the wholly-owned subsidiary has not accomplished the antitrust objective. SBC remains an aid to IBM's marketing of computers—in part because SBC uses IBM equipment. As a result, the data of SBC customers are still prepared on IBM media and to IBM software requirements, and so, when those customers subsequently install their own computer, any choice but an IBM computer would entail a significant cost for the conversion of the data to a new media and re-writing or modifying software. Thus SBC's activities aid IBM in maintaining its monopolistic position in the manufacturing of general purpose computers and marketing them to customers including service bureaus and other data service vendors. (In addition, SBC has been a conduit for price discrimination by IBM in the sale of computers through free use of computers, free program support, and buybacks of computer time or programs.)

A broad market for data services has developed and includes the following either separately or in combination:

1. Sales of computer time locally on site.

2. Sale of computer time via communication lines and terminals to a remote site including what is sometimes referred to as time-sharing (interactive) or batch (non-interactive) computing.

3. The sale of subscription services involving the use of a computer on a flat rate or time basis.

4. The sale of facilities management to provide some or all of the data processing services for a particular customer including management, equipment, programming and operating personnel, programs, communications and the space or buildings for physically housing the operations.

(The sale of data services always involves the use of a computer system and may or may not include operators, programs, data bases, remote terminal rental and communications facilities costs.)

The growth of the data services market will intensify IBM's advantages in its ownership of SBC. Time-sharing or remote computing permits a customer to achieve the economies and computing power of large scale computers through using a terminal linked to a centrally located large scale computer used concurrently by several users. Such a system spreads the costs of a large scale computer over many users and for this reason, the demand is expected to grow rapidly in the coming decades. For example, extensive computer aided instruction for local schools will become feasible only in a time-shared mode.

IBM, with its dominant position in the manufacture and marketing of general purpose computers, is in a position to dominate the emerging data services market. With its full range of products including large central processors, minicomputers and other remote terminals along with the vast library of network and applications software, IBM can establish facilities to provide data services at less cost than competitors. IBM's vast resources would enable them to blanket the country with networks and centers if they chose.

B. The Suggested Relief

SBC would be divested by IBM and established as a totally independent company, and IBM barred from re-entering, by acquisition or internal expansion, the data services business. SBC and other service bureaus may still use IBM general purpose computers.

C. Evaluation

The feasibility of such divestiture is demonstrated by the fact that IBM has been required to operate SBC as an independent "arms-length" subsidiary since 1956.

A divorcement of IBM from the data services market including a totally independent SBC is the only way to insure that marketing data services does not assist IBM in maintaining its monopoly position in the sale of general purpose computers. An independent SBC, combined with a prohibition against IBM's directly engaging in providing computer services, would also remove the major threat of IBM's domination of the data services market. In addition, SBC might become a substantial equipment customer for IBM's rivals in the general purpose computer market.

IV. Divorcement of IBM from Professional Services and Education Activities, and Divestiture of SRA.

A. The Problem

The manufacture and marketing of hardware (main frame computers and peripheral equipment) will continue to be the most important segment of the industry for the foreseeable future—for they are the heart of any computing system. However, hardware now represent less than 50% of the users expenditure for data processing. Computer training or education and professional services, will become even more important in the coming decades.

By professional services we mean consulting and programming services on a contract or fee basis. Consulting services includes systems analysis and design, systems engineering and specifications, feasibility studies, systems selection, architectural design, and similar activities. Programming services include the designing and implementing of programs for the application of computers including application design and development, program design and development, program conversion, testing and implementation as related to specific user applications. Program products developed internally at IBM and licensed for a fee—including operating systems, computers, applications programs, and utility routines—are not included in this definition.

Education includes training of operators, programmers, maintenance and management personnel in the computer field.

The user's experience with a particular manufacturer's computer is closely related to the marketing of general purpose computers. IBM has capitalized on this linkage by offering massive educational discounts on computer systems to major universities. The importance of the major universities in influencing the computer purchase decisions of large groups of users will likely be matched in the future by other kinds of computer education and training. While the training of key scientists remains important, industry trends indicate the growth of educational courses now offered by commercial schools in major urban areas to

train the large number of highly skilled technicians and to provide refresher training for these technicians to work effectively with the rapidly changing technology. IBM already has a major edge in such training because most commercial schools use IBM equipment. IBM also has begun to offer such training directly, including the operation of its System Science Institute.

Any expansion into the education market by IBM with its massive resources, could well be a key element in perpetuating IBM's market dominance in the general purpose computer market. Thus, IBM's participation in the educational market in the '70s and '80s could substitute for its massive educational discounts of the '60s. The relief proposed is addressed to preventing this way of perpetuating dominance in the general purpose computer market, as well as preventing the potential dominance of the educational services market by IBM.

Professional services present an analogous problem. Until recently IBM often gave away such services and realized a return on these "free goods" through continued dominance of the general purpose computer market. Now that many users have well established computer installations, services that add to the efficiency and extend the range of computer usage will be more important. Computers are being applied to problems requiring a higher order of expertise which call for more reliance on highly-specialized consultants and programmers.

Now that unbundling creates the prospect of a free market in professional services, and this market is likely to grow rapidly, IBM may attempt to dominate this market to further enhance its sales of general purpose computers. Its resources, including the fact that it has the largest number of computer professionals of any company in the world, provides the potential for IBM to dominate the professional services market. Again, the relief proposal serves to loosen IBM's hold on the general purpose computer market, as well as to prevent IBM dominance of this rapidly growing service market.

B. The Suggested Relief

IBM should be divorced from the business of providing educational and professional services. IBM would be allowed to continue to engage in the training of its own employees, and to offer training directly associated with the sale or lease of IBM computer systems, but these latter services should be clearly specified at time of sale and limited to those associated with the initial operation of newly acquired equipment.

Inasmuch as the business of SRA is closely related to the educational services market, that wholly-owned subsidiary, which has been operated independently by IBM since its acquisition, should be divested.

C. Evaluation

These services lend themselves to provision by a large number of competitors which (subject to potential exclusion by an exercise of IBM's power) are already fully capable of providing the required services. In particular, the independent software houses would benefit if IBM were prohibited from using its hardware dominance as a wedge to usurp the position of such companies in developing software. The continued viability of these independent companies, and the continuation of competition in these markets, can be insured by divorcing IBM from these businesses and confining IBM to the principal business of manufacturing and marketing computer systems. No feasibility problem presents itself with respect to such relief.

V. Divestiture of IBM's Office Products Division and Divorcement of IBM from the Type of Business Conducted by that Division.

A. The Problem

This IBM division develops, manufactures, markets and services computer-related (or potentially computer-related) office products, the most important of which is typewriters. IBM is the dominant manufacturer of office electric typewriters, having 86 percent of the heavy-duty office typewriter market according to the February, 1972 initial decision of the FTC hearing examiner in the *Litton Industries* case. Given the universality of the use of the typewriter, this product gives IBM salesmen and maintenance men, as well as its office systems and procedure personnel, access to almost every office in the country.

Typewriters are used as data preparation devices for entry of data into computer systems. This can be accomplished via optical character recognition type fonts on the typewriter or through auxiliary equipment that uses the typewriter to produce machine readable media, such as paper or magnetic tape. Typewriters are also used as output devices to print hard copy after computer processing.

In addition, typewriters are used for computer consoles. Further, as highlighted in IBM's 1971 annual report, IBM typewriters are a major element of the remote terminals made by IBM and those made by its competitors as well. Almost all the computer manufacturers, therefore, are dependent to some extent on IBM typewriters. Moreover, office copiers, a product line IBM recently entered, are, with some modification, beginning to be used as computer output devices and could serve as a further means of tying the customer.

IBM's commanding position in typewriters helps to maintain its dominant position in the general purposes computer market in several ways: (1) IBM has an entry into almost every small business in the country, most of which are potential, if not present, computer users; (2) IBM can learn customer business systems and procedures, and educate the customer to IBM's "way of thinking" so as to condition them to the use of IBM computers; and (3) typewriters and office copiers provide a springboard for the design and sale of comprehensive information systems that are likely to have a major computer application in the future.

Conversely, the sale of computer systems often requires or includes a large number of typewriters for data entry, either directly connected as terminals or to prepare data for optical character reader entry.

B. The Suggested Relief

IBM's Office Products Division would be divested and established as an independent company. IBM would be barred from re-entry into this line of business, through acquisition or internal expansion.

C. Evaluation

The Office Products Division is operated as a separate entity, with its own research, manufacturing plants, management, and sales operation. There is no question as to the economic feasibility of divesture. Office Products would be a successful independent company—in fact, the leading company in typewriters.

Freed of IBM ties, office products would no longer be a marketing asset which IBM can use in the computer markets in an anti-competitive way. These products would be freely available to other manufacturers and at non-discriminatory prices. As an additional benefit, IBM's monopoly or near-monopoly position in office typewriters would be transferred to one or more independent companies whose power would be considerably lessened by virtue of the absence of the integrated support of IBM's massive computer resources.

Obviously such divorcement, as well as the other divorcement provisions proposed above, need not be permanent. If and when it could be demonstrated that such markets would benefit from the entry of IBM, the decree could be modified, at the motion of either the government or IBM. At this point in time, that possibility appears very remote.

MANDATORY RELIEF TO ACHIEVE COMPATIBILITY

VI. Mandatory Advance Disclosure of Technology, and Mandatory Use of Standards Required to Achieve Compatibility.

A. The Problem

IBM establishes most of the standards for the entire computer industry, particularly for interchangeable media. This is recognized, for example, in an Organization for Economic Cooperation and Development (OECD) publication (*Gaps in Technology: Computers* (Paris, 1969)), which states (at pp. 66–67): "IBM can be said to set the standards, at least in the commercial market by virtue of the fact that it is the largest company and the fact that a majority of computer users have been trained by IBM and use IBM equipment . . . In the case of the computer industry, the result is that what IBM does tends to become the standard for the whole industry by virtue of IBM's market share and the determination of certain smaller companies to 'follow IBM' whatever happens."

IBM's power over standards is further intensified by its role as the only computer manufacturer producing a full line of computers and peripheral equipment. Many customers require compatibility among computers of varying sizes, because they wish to use the same applications programs on more than one system or because they may interchange their peripheral equipment between several computers. The customer's desire for compatibilty, along with IBM's full line and great size, requires manufacturers to make their equipment compatible at least in some degree with IBM products in order to serve any substantial portion of the market.

Some definitions are in order to understand the importance of standards and the methods that are employed to IBM's advantage:

1. Compatibility

Compatibility is used broadly to indicate degrees of interchangeability of various elements in a computer system. Most frequently these are:

(a) *Interchangeable media* are said to be compatible if the media from two different sources can be used interchangeably on a given computer system with no modification to either the media or the system. This requires physical, electrical, environmental as well as data format equivalent through the establishment of standards for all relevant characteristics. Punched cards or magnetic tapes are examples.

(b) *Module or functional compatibility* refers to the ability to interchange functional modules between two different computer systems. Examples are punched card readers, magnetic tape transports, memories, etc. These devices are said to be "plug-to-plug compatible" if the plug connecting a particular module to a system can be unplugged and a different "plug compatible" module can be plugged into the system to perform a similar or identical function with no modification to either the module or the system. To achieve this form of compatibility "interface standards" are required for both the points of interconnection, such as the plug between the module and the system.

(c) *Systems and software* are said to be compatible if data as represented on an interchangeable media or received from an electrical connection is in a form and format such that it can be entered into either of two compatible systems. Similarly, two different systems are said to be "software compatible" if the programs written for one system can process data efficiently when the programs and data are entered into the second system without modification. Compatibility of this type requires a large number of standards ranging from those for the interchangeable media or inter-connection, the codes and format for data, to those for the internal operations to be performed upon various software or program commands. Systems other than those of a single model of a single manufacturer are rarely completely compatible but compatibility of varying degrees can be achieved if sufficient standards and specifications are available.

2. Standards

Standards are accepted criteria or measures of performance, practice, design, terminology, etc., that are established and controlled by a suitable authority. Among the more important standards to the relief here proposed are performance standards and interface standards:

(a) *Performance standards* are used to define characteristics to permit a comparison of performance of two different entities.

(b) *Interface standards* are used to define interconnections and interrelationship between separable modules defined by the function they perform. Most frequently these standards take the form of combinations of physical and electrical specifications and rules or principles required for interconnections.

Competitors are forced to provide functional and often compatible equivalents to IBM products in order to be responsive to customers' requests for proposals. Thus, when only IBM can achieve new product acceptance and standards through wide usage, a clear advantage is established.

Two examples of standards resulting from IBM's dominance in the computer industry are those for punched cards and magnetic tape. In the case of punched cards, prior to the evolution of the computer industry there were Hollerith cards with 80 columns of two rectangular holes each and Remington Rand cards with 90 columns of round holes. Advantages were claimed for the rectangular holes when hole sensing was electromechanical by means of electrical brushes making contact through the rectangular holes in tabulating equipment. Computing equipment card readers have used photoelectric hole sensing since the development of high speed readers. The greater number of holes in the 90-column card clearly provided an advantage for computer use since it allows for recording more data, and round holes have a clear advantage because they can be punched to required tolerances more easily. The round-holed, 90-column card punch dies are also more readily manufactured than rectangular-holed ones. In spite of these clear technological advantages of the 90-column card, both industry and government have standardized on the "IBM" 80-column rectangular hole cards based purely on the number of users of the IBM card resulting from IBM's dominance. Proof of technological superiority of the 90-column round hole cards was clearly demonstrated by IBM's new card offering with 96 columns of round holes.

In the case of magnetic tape, the first Univac was delivered with magnetic tape transports. Instead of adopting these standards, IBM provided transports with different characteristics and again the industry has standardized on the IBM tape standards based on greater usage.

IBM has used its power as a standards-setter to create monopolies for its own equipment. When a new IBM product or modification of a product which affects compatibility is introduced, other manufacturers must introduce a new product or modify their equipment to conform to the new IBM change in order to bid competitively. Such modifications take time and the investment of resources; in the interim IBM has the entire field to itself.

This aspect of IBM's monopoly power has lasting effects on competition. IBM has a head start by initially establishing its product standards and controlling changes and so can establish a lasting lead. IBM insures the full advantage of its head start by carefully avoiding the release of any change in standards prior to the introduction date of the new products.

IBM's competitors in the computer market are in an almost impossible position. They can seldom innovate in areas impacting on interface technology because customers regard IBM equipment as the norm given IBM's great relative size and full line. They lack the resources to challenge IBM's standard-setting role. Since IBM fails to disclose these changes in advance, competitors can never be as timely as IBM. They can only frantically try to recover their market after each IBM shift or new standard.

The problems of IBM's product changes without forewarning also adversely affects software houses, because, given IBM's overwhelming share of the hardware market, their software products are almost exclusively designed for use on IBM equipment. Like the hardware manufacturers, software houses find that the timing of IBM of both new developments and modifications to existing hardware and software products places them at a substantial competitive disadvantage by at least temporarily outmoding their own products.

A closely related problem to that of standardization is the compatibility of computer programs. IBM and its customers have developed the greatest variety of programs, particularly for various computer applications. Furthermore, with IBM equipment so common, users and independent software specialists devote most of their efforts to developing programs for IBM equipment to reach the largest market. Much of this application programming is written in IBM assembly or machine language, thus limiting their usefulness to IBM computers. In contrast programs written in standard higher-order computer languages—such as FORTRAN and COBOL—can be run on most any computer for which a FORTRAN or COBOL compiler of the same specifications have been developed with minimal or no modification.

Competitive manufacturers are precluded from competitive procurements simply because they lack the specific applications programs required and cannot use IBM machine language programs even if they are available. At the same time, present IBM customers are locked-in by assembly language programs and because of the conversion cost cannot afford to change to competitive systems. Notably, CDC finds it has on the order of five times greater probability of making a sale to a user who programs in machine independent language.

The remedy is to have applications software written in higher order compiler languages that are specifically designed to be machine independent. Furthermore, they are standard languages approved by the standards organization for the computer industry: American National Standards Institute (ANSI) X3 Committee comprising representatives of many users and manufacturers. They also constitute ederal Information Processing Standards (FIPS) for the Federal Government.

The use of such standard compiler languages for applications software would allow all users to benefit from new applications program developments and allow users to shift between competitive equipments without making a large re-programming investment. Compiler language programs may be less efficient than assembly language programs in terms of machine time, but there are compensating savings for compatibility in reduced programming time to write in these languages and in greater ease in modification and correction of programs. This requirement would also permit and encourage development of more efficient machine designs for processing compiler language programs.

When programs are written in higher-order compiler language, additional standards are required to provide the greatest degree of compatibility between systems of different manufacturers. These standards relate to input/output, job control, and data files and data structure, as well as other affected areas.

Standards are under development for many of these areas by the BEMA-sponsored X3 Computer Standards Committee under ANSI. In addition, NBS has recognized the necessity of these standards and, as the government organization responsible for FIPS, the future adoption of such standards can be anticipated. The use of these standards, when developed, in combination with the higher-order languages, will be required to achieve the degree of compatibility desired for relief from IBM's control and power to lock in customers.

B. The Suggested Relief

IBM should be required to disclose confidentially to other U.S. manufacturers product specifications relating to compatibility, such as media specifications, and machine interface specifications, 24 months prior to the sale of the new or changed product. This pre-sale release requirement should also extend to input/output, file and data structure, and job control languages.

With respect to machine language, IBM should be required to write all its future applications programs in higher-order compiler languages for which ANSI or FIPS standards have been approved and released. In addition, IBM's input/output, job control, data file and data structure methodology shall conform to ANSI or FIPS standards when standards for these areas have been established.

C. Evaluation

The 24 month prior notice requirement would reduce IBM's head start and give competing manufacturers a chance to make product introductions within a time frame competitive with that of IBM. The greater use of common languages and other software standards increases the customer's freedom of choice by permitting the selection of data processing equipment on its relative merits and prices, unimpeded by the costs of re-programming.

Additionally, prior release of product specifications and the software standards requirement would dilute IBM's power in several specific ways:

(1) As discussed in CDC's preliminary Pre-Trial Memorandum, IBM's predominant market share is not only a reflection of its market power, but it is also a source of that power in that its predominant market share is self-perpetuating. It is self-perpetuating because the fact that the great majority of installed computers are IBM computers is, in and of itself, a strong inducement to a prospective customer to acquire an IBM machine. This is so because the vast number of IBM installations necessarily means that (a) there is a much greater amount of software and trained personnel available to the user, (b) there is a large amount of "back-up" computing time (on IBM machines) available, or conversely, a large number of users who might purchase unused time from the customer on its computer, and (c) there is a large number of buyers for the computer as a "used" computer if and when the customer wishes to dispose of it. This self-perpetuating effect of IBM's predominant market share would be minimized if the above compatibility measures were required.

(2) The self-perpetuating effect is equally applicable to a current IBM customer. In addition, the current IBM user is locked in to IBM for additional or replacement computers because of the high cost of converting to non-IBM equipment. If non-IBM equipment and device dependent software were compatible, this lock-in effect (a "physical" rather than contractual bundling) would be eliminated, and computer could be acquired on its merits.

(3) For software, the shift to higher-order complier languages would encourage computers to be designed to operate more efficiently on programs written in these languages. The use of such software standards, including compiler languages in developing applications programs, would allow all users to benefit from new IBM developments in applications programs and allow users to shift to competitive equipment without making a large re-programming investment. The general importance of compatibility of software not only for competition but for economic efficiency is reflected in the OECD report:

"For a long time the problem of compatibility has been one of the most important ones of the industry, and this for many reasons. Lack of compatibility has for instance deterred many users from going to other manufacturers, owing to the high cost of rewriting their programs; moreover, manufacturers themselves have found the lack of compatibility between their own computers was creating tremendous wastages."

(4) To achieve hardware, interface and media compatibility, advance disclosure by IBM of new product performance, standards and changes to current products is important not only for computer manufacturers, but for independent manufacturers of peripheral and terminal equipment, and for users.

In short, the compatibility measures suggested here would enhance competition in several markets.

RELIEF AGAINST SPECIFIC EXCLUSIONARY PRACTICES

In contrast to the more expansive treatment accorded to the foregoing relief measures, we will discuss only briefly the following interrelated items of specific injunctive relief.* This cursory treatment does not reflect their lack of importance. Rather, the practices are so obviously anti-competitive, and their prohibition so obviously warranted, that brevity seems appropriate.

All of the proposed injunctions should apply equally to World Trade Corporation where there is growing evidence of extremely predatory behavior.

VII. Prohibition Against Bundling.

A. The Problem

For many years, IBM sold its computer systems, software and support services for a single (bundled) price, and refused to sell any one of those "products" alone. Because IBM has overwhelming market power in all three of those areas, it was able to use its power in any one area as a tying device to the other areas. This in effect requires customers to pay for services and products that they may not desire or be able to use. The current government complaint alleges that bundling has been one of the principal exclusionary practices whereby IBM maintained its monopoly power over the industry.

B. The Suggested Relief

In June of 1969, IBM "voluntarily" unbundled many of its support services and software from its computer systems, but there have been rumors that a partial "rebundling" is being contemplated. IBM should be required to unbundle all of its services and software with the possible exception of operating systems.

C. Evaluation

Untying this exclusionary knot will eliminate an obstacle that stands in the way of other systems manufacturers in their efforts to market their products on their merits. This relief would be particularly efficacious when combined with the compatibility relief suggested above. Additionally, the beneficial results of unbundling extend to the computer related markets by removing an impediment to the selling of maintenance, software, etc. by the independent companies in those markets.

VIII. Prohibition Against Granting Hidden Discounts.

A. The Problem

IBM has historically provided cusotmers with economic incentives, beyond direct price reductions, in order to maintain standard lease prices, and thus not affect their lease base, and still be able to offer what amounts to reduced prices to selected customers. These hidden and indirect discounts and concessions take various forms, including agreements to provide services such as analysts or other manpower at no charge ("manpower give-aways"), promises to develop software at no charge ("software give-aways"), agreements for joint software development with customers (an activity apparently to be expanded, as announced early this year by President Cary of IBM), purchasing software or buying back machine time from the customer ("buy-backs"), grants for research or computer centers, etc., etc. These indirect, hidden concessions and discounts make it extremely difficult for competitors to engage in direct price competition on the merits of their products.

B. The Suggested Relief

IBM should be required to publish a separate price list, which would include terms of sale such as credit, trade-in allowances, etc., for (1) each unit of hardware, (2) applications software, (3) maintenance services, (4) any other products or services provided by IBM as a part of the sale and support of computers. (If the suggested remedy of divorcement of IBM from the computer related services business is not adopted, then such services, i.e., education or training, programming, and consulting should also be subject to this injunction.)

*IBM should be enjoined from all 37 exclusionary practices alleged in Control Data's complaint, the practices discussed briefly here being among those where immediate relief is most necessary.

All sales and leases should be made at this published price except where deviations are justified to meet competition. Where deviations are made, IBM should be required to disclose publicly the aggregate "net" price for each sale or lease it consummates. It should also make known its complete terms of sale during each competitive procurement, so that the other bidders have an opportunity to engage in open price competition.

C. Evaluation

The relief suggested here should be considered in light of our proposals regarding unbundling and the divorcement of IBM from the computer services markets, because the historical "packaging" of various hardware products, software products and "support" services permitted IBM to hide discounts and conceal the net price it was charging. "Auto sticker" pricing will permit other main frame companies to engage in more effetcive price competition. This open-pricing relief must also be considered in conjunction with the proposed injunction against exhorbitant discounts—even on a published basis—discussed next.

IX. Prohibition Against Extensive Discriminatory Pricing.

A. The Problem

Historically, IBM has confined the practice of massive price-cutting to its so-called educational discount, which has varied from 60% to 20%. As alleged in the pending government complaint, IBM used this educational discount practice as a means to arrogate to itself the major share of university business, not only for the immediate hardware sales that it fostered, but also for the long-term entrenchment benefit stemming from the built-in bias toward IBM which resulted from the exposure to and familiarity with IBM equipment on the part of faculty, students and advisors. While IBM "voluntarily" has reduced this discount, there is nothing to prevent IBM from re-instituting it or from instituting a similar discount for other types of customers, thereby effectively locking out competition.

B. The Suggested Relief

IBM should be prohibited from publishing (or charging) any extensive discount schedule for any type of customer for the purpose of injuring competition.

C. Evaluation

CDC's Preliminary Pre-Trial Memorandum demonstrates that IBM's educational discount policy was not altruistically motivated. It was designed as a device to perpetuate its predominant share of the computer markets and, as such, should be enjoined. Reasonable discounts for non-profit and similar institutions would still be permissible.

X. Prohibition Against Predatory ("Fighting Machine") Pricing.

A. The Problem

IBM is the only main frame manufacturer with a complete line of products both hardware and software. This fact, combined with the fact that its market share is more than ten times its nearest rival, necessarily means that IBM faces little or no competition with respect to many of its computers and other products. Such products, both hardware and software, can be and are priced at monopoly profit levels, while those products which face present or imminent competition are priced at levels resulting in abnormally low profits—or priced below cost. IBM has employed this power of selective pricing—the favorite tool of a monopolist—to subjugate its competitors.

B. The Suggested Relief

IBM should be enjoined from (1) entering into the production of computer hardware or software which is not likely to result in returns reasonably related to the returns from other computer products marketed by IBM, and (2) pricing any product at a low-profit or non-profit level with the intent to injure a competitor.

C. Evaluation

The three relief measures previously discussed would require IBM to price each of its products separately and on its own merits, to disclose such price openly, and to refrain from discounting in favor of a particular group of customers for the purpose of injuring competition. This complementary fourth measure is necessary to insure a fair and non-monopolistic pricing approach by IBM. The well-known "fighting machine" practice is just as anti-competitive

as the illegal practice of the national seller cutting his prices in the confined territory of the local competitor, making up for his losses by the exorbitant profits made on sales effected where he faces no competition. Unless this pricing power of IBM is checked the competitors will continue to face the potential of extinction.

XI. Prohibition Against "Paper Machine" Practices.

A. The Problem

Closely related to the fighting machine practice of IBM is its practice of prematurely announcing new or modified computer products for the purpose of warding off buyer commitments to a competitor's product. In view of the "security-blanket" approach of so many computer users, IBM is fully aware that many customers will delay a purchase decision if they understand that IBM intends to market a "competing" product. This fraudulent practice has been used by IBM with devastating results to CDC, especially when a paper machine was priced—futuristically—as a fighting machine.

B. The Suggested Relief

IBM should be prohibited from announcing (or disclosing in any way) plans for a new product unless and until (1) detailed design and performance specifications have been estabilshed for the product, (2) the product plans have progressed to the point where the commencement-of-manufacturing date is reasonably certain, and (3) a complete prototype is in existence and has passed tests validating the design and performance specifications which have been established; the results of such tests should be made available to the general public at the time of the product announcement.

C. Evaluation

IBM's paper machines severely disrupted the development of large-scale computers, and are capable of inflicting similar damage in other areas. The suggested relief attacks this practice head-on, but still leaves IBM completely free to innovate and successfully market hardware and software products—if the product is real and not just a figment of IBM's imagination. Besides being hurtful to IBM's competition, the marketing of such products before they are truly operative and perform as represented is damaging to the image of the United States as the world's leader in computer manufacturing.

CONCLUSION

We are cognizant of the fact that much has been said and written to the effect that, even assuming that IBM is guilty of the monopolization charge set forth in the government's and CDC's pending complaints—and thus possesses the power to exclude competition in the general-purpose computer market—nothing can be done to remedy the situation. We do not subscribe to this defeatist attitude. The structural and other relief measures suggested in this memorandum are feasible, forward-looking and meaningful, without falling in the "drastic" category.

In our opinion, these measures are minimally essential if the United States is to retain its leadership in computers, for any industry which has been monopolized by a single company is, by hypothesis, a very vulnerable industry. The effect of the relief proposed is to strengthen the industry by creating a competitive environment for IBM's rivals which will permit their survival in the computer-manufacturing market, and also allow them room to grow, unimpeded by IBM's power and exclusionary practices, in computer-related markets. At the same time, the relief suggested would leave IBM fundamentally strong in its traditional role as a manufacturer and marketer of computer systems.

The benefits of the aggregate relief proposed to the industry, to the public and to the national interest are far-reaching:

1. The economies of scale in manufacturing components will be shared by all computer companies.
2. Technological progress will be accelerated by virtue of eliminating IBM's de facto standards power and its resultant ability to structure the market which locks in users to IBM products and thereby forecloses IBM's competitors.
3. With IBM prohibited from extending its dominance into certain computer-related markets, small companies including new entrants can flourish and innovate, thus permitting users to purchase products and services on the merits of the competitive offerings.

4. The remaining general purpose computer manufacturers will be enabled to survive, and hopefully to grow in strength and innovative capacity, without dismantling IBM.

5. Assuming competition is restored by these measures, and the industry is thereby strengthened, the American export position in computers and related products will be improved, and the industry's capability to provide the necessary tools for the Nation's defense and scientific explorations will be substantially enhanced.

Exhibit 5.—*Joint position statement of Control Data Corp., Honeywell, National Cash Register, Sperry Rand re United States v. IBM*

JOINT POSITION OF CONTROL DATA CORPORATION, HONEYWELL, THE NATIONAL CASH REGISTER COMPANY, SPERRY RAND CORPORATION, RE RELIEF MATTERS IN U.S. *v.* IBM

The following positions, each of which will be briefly elaborated on in the following pages, are held in common by these four companies:

1. *Early* relief is indispensable to insure a possibility of the restoration of competition. This requires the immediate formulation of a comprehensive plan for *interim* relief. Although emphasis should be on *post*-trial interim relief, *i.e.*, relief to take effect soon after violation has been found and to terminate upon the effective date of the ultimate relief, a *pre*-trial injunction might be warranted under certain circumstances, provided that the preparation for and the hearing on a motion for such relief would not impede the forward progress of trial preparation and delay the commencement of trial.

2. The post-trial interim relief plan should include "structural", as well as behavioral, provisions designed to safeguard the industry during the extensive period of appeals and during the process of formulating the ultimate relief.

3. To the end that interim relief should take effect as soon as possible, the Antitrust Division should make an effort to obtain a court order separating the issue of violation from the issue of ultimate relief.

4. The Antitrust Division's position as regards the complex question of ultimate relief should not be finally resolved until the point in time when the imposition of such relief is fairly close and the industry and other relevant facts which then exist are known. We collectively reiterate the positions already individually recited by each of our four companies that, under the present circumstances, it is our judgment that the divestiture proposed in the October, 1972 relief memorandum filed with the Court by the Antitrust Division would not restore competition to the industry and achieve the objectives of the Sherman Act. However, we do believe that consideration must necessarily be given to divestiture of a type which is appropriate under the circumstances at the time and to divestiture, and other relief, on a world-wide basis.

I. AN EFFECTIVE INTERIM RELIEF PLAN IS NECESSARY AND FEASIBLE

The need for early, interim relief can be understood only in light of the probable time of commencement of the ultimate relief measures and the likelihood of significant changes in the industry before ultimate relief becomes effective. For present purposes, we assume that the trial will start sometime in 1974 and last for approximately one year. Because of the complexities involved in the litigation and the obvious volume of the trial record, the appellate process will probably take years, and the possibility of more than one appeal cannot be discounted.* The ultimate relief-formulation process will also be extremely time-consuming, because of the likelihood that relief will be proposed and presented by numerous interested groups and individuals, inside and outside government. In view of the importance of the issue, the District Court will be inclined to seriously consider the pros and cons of all such proposals before entering its final judgment incorporating the ultimate relief plan.

All of this means that ultimate relief probably cannot become fully effective in this decade. But if IBM's dominance remains unchecked until the 1980's, the computer industry may suffer an irretrievable setback. Without delving into

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*This process may be even lengthier in the Expediting Act is amended so as to provide for appeals in government injunction cases to the Courts of Appeal.

the cause and effect relationship between IBM's dominance and the departures, including those of GE and RCA, from the computer industry, the fact remains that the number of IBM mainframe competitors is now down to only a handful. Their continued viability through the critical years comprising the second half of this decade must not be impaired.

An effective interim relief plan could provide assurance in this respect. The underlying assumption of this Memorandum is that the government will establish a monopolization violation at the trial, and a monopolization finding necessarily means that the District Court will have found that IBM has the power to exclude competitors from the market. In light of such an adjudication, and in light of the obvious difficulty and time-consuming nature of resolving the ultimate relief problem, the undersigned companies feel that the Antitrust Division might well persuade the District Court, without the need for extensive hearings, to enter an order calling for effective interim relief. The necessity for such interim relief measures was recognized by the Supreme Court in one of the earliest Sherman Act cases:

"(The relief) subject necessarily takes a two-fold aspect.—the character of the permanent relief required, and the nature of the temporary relief essential to be applied pending the working out of permanent relief in the event that it be found that it is impossible, under the situation as it now exists, to at once rectify such existing wrongful condition . . . Pending the bringing about of the result just stated, each and all of the defendants, individuals as well as corporations, should be restrained from doing any act which might further extend or enlarge the power of the combination, by any means or device whatsoever." *U.S. v. American Tobacco Co.*, 221 U.S. 106, 31 S. Ct. 632, 650, 651 (1911).

II. THE INTERIM RELIEF PLAN SHOULD INCLUDE STRUCTURAL PROVISIONS

The need for post-trial interim relief has been expressly recognized by the Antitrust Division in its October, 1972 preliminary memorandum on relief. But the undersigned companies entertain serious doubts as to whether the combination of the "anti-scrambling" provisions of section II of that memorandum, and the behavioral injunctions of section III, are sufficient in scope to accomplish the objective of not permitting the situation in the industry to worsen during the immediate post-trial years. It must be recognized that, if and when IBM has been adjudicated to be a monopolist—at which point IBM would be confronted with the possibility of dismemberment, as outlined in the Department's October, 1972 memorandum—IBM's management would have every incentive, as well as the capability, to substantially increase its market share, so as to be able to "bequeath" such additional business to the IBM successor companies. Any such increased pre-divestiture dominance would of course benefit the IBM "Newcos", but the corresponding loss of market share by current IBM competitors might prove disastrous for one or more of them.

We see no effective way to preclude that eventuality, short of the "controlled growth" approach suggested here. In essence, the proposed controlled growth remedy would prevent IBM from increasing its market share. This prohibition against excessive growth would apply to identifiable segments of the computer market, and also to the computer-related markets which likewise would be vulnerable to an IBM take-over during the post-adjudication period. Some of the details of the controlled growth remedy, together with an outline of the other features of the proposed interim relief plan (*i.e.*, behavioral injunctions and provisions assuring access to IBM products and technology), are set forth in Appendix A to this Memorandum.*

We have characterized the controlled growth remedy as "structural" because it directly addresses the central issue of preservation of competition and is unrelated to behavioral practices. But the proposal is designed to *preserve* the current market structure, not to alter it, and thus is consonant with the interim relief concept of maintenance of status quo. We are aware of the fact that remedies imposed on an interim relief basis must be reversible because of the possibility that the adjudication of the trial court might not be affirmed. Neither the controlled growth remedy nor the other suggested measures fall into the irreversible category. Rather, they are designed to preserve the current market structure and thus obviate the possibility that the entire objective of the government's

*Similar behavioral injunctions against IBM may be in effect at the time of adjudication. In *Telex* v. *IBM*, the District Court in September, 1973 granted injunctions embracing some portions of Interim Relief Measures Nos. 1, 2 and 6 of Appendix A.

case—the infusion of competition into the computer industry—will be frustrated before final relief is entered.

III. THE VIOLATION ISSUE SHOULD BE SEPARATED FROM THE ULTIMATE RELIEF ISSUE

The Department should take whatever steps are necessary to obtain an adjudication against IBM as soon as feasible, which adjudication will permit the imposition of effective, and early, interim relief. A separation of the two principal trial issues will assist in meeting that objective in two ways. First, if the parties are freed at this time from the burden of preparing the evidence and arguments in support of their respective positions on ultimate relief, the trial-commencement date can be accelerated; and second, the duration of an initial trial limited to the violation issue would be substantially shorter than a single trial of the combined issues, thus allowing the entry of the trial court's findings as to the monopolization issue at a much earlier date than otherwise.

We realize that to accomplish such a separation is not within the government's discretion but rather that of the District Court. And we assume that IBM, desiring to delay the day of adjudication as long as possible, would resist a government motion for a separate trial. Still, an issue-separation approach of this kind is not uncommon in government antitrust cases, and we would urge the Antitrust Division to seek such a separation in view of the following resultant advantages that are in addition to the interim relief objective mentioned above:

1. If the violation issue is dispositive in favor of IBM, many months of the Court's time and one of the Division's efforts will be saved.
2. If violation is found (and that is the assumption underlying this Memorandum), the District Court can then address the ultimate relief problem in light of the understanding of the complex industry which will have been gained in the process of hearing the evidence on the violation issue and formulating its findings.
3. Against the background of such an understanding of the industry, the relief issue can be addressed in light of the then current facts and trends in the industry, national and international economic considerations, etc.
4. No duplication of evidence would be involved. Certain key witnesses would have to appear a second time, but their testimony would be more meaningful if given after the Court's findings on the monopolization issue. For example, in an undivided trial context, testimony on the cental issue of what is needed to dissipate IBM's market power has to be given on the basis of *assumptions* as to the nature and scope of that power, while in a separated trial context, such testimony would be given in light of the District Court's extensive findings on the market definition and market power issues.
5. The suggested separation of issues does not necessarily affect the question of whether one or two appeals will be taken. Depending on the definition of the issues to be separated, the Court can infuse in or withhold from, its initial findings the requisite "finality" determinative of IBM's right to appeal at that point. But in either event, interim relief measures could take effect shortly after (if not before) such initial findings and remain in effect at least until the entry of the final judgment setting forth all of the deails of the ultimate relief package.

IV. THE RESOLUTION OF THE ULTIMATE RELIEF QUESTION SHOULD BE DEFERRED

The government's tentative proposal for ultimate relief, as we understand it, contemplates the division of IBM into "several" (presumably 5 to 8) balanced mainframe manufacturers which offer a relatively full line of computer systems. In our view, that plan is fraught with substantial risks and difficulties. Assuming that the feasibility problems involving plant-splitting and the use of foreign-located assets can be overcome, the risk of economic waste by way of transitional costs and the risk of creating a shared monopoly remain.

Substantial transitional costs are necessarily involved. Among the more obvious are the economic wastes inherent in dividing basic research and developmental work in progress, transferring production, and allocating successor responsibilities regarding support of IBM equipment in the field.

Another aspect of the transitional costs of the dismemberment plan proposed in the Antitrust Division's October, 1972 relief memorandum would be the slow-up in the market as users hold up their procurement decisions until there is less uncertainty as to the new structure of the industry. Such a slow-up, aggravated by the continuing IBM de facto standards, would probably involve a freeze on technological progress to the detriment of computer users, and hence the public.

It is likely to adversely affect all of the firms in the industry, and especially the non-IBM companies because they lack the cash flow from an extensive lease base to sustain them during the transitional years.

More importantly, the final outcome of the dismemberment plan in the Antitrust Division's October, 1972 relief memorandum is likely to leave the IBM successor companies as dominant firms. Depending in part on the efficacy of interim relief, the successor companies will be substantially larger than the non-IBM mainframe companies and will have the further advantage, which could prove decisive, of a very sizeable lease base coupled with a compatible product line among themselves. With a head start from size and lease base, and sheltered by systems/data base compatibility barriers and the other aspects of the "technological lock-in",* the successor IBM companies might well succeed not only to the assets of IBM but also to its predominance in the industry. This would not only fail to return true differentiated competition to the market place, but rather would set apart one group of competitors with significant advantages over other competitors.

Converting single-firm dominance to shared monopoly power is not, in our view, of sufficient public benefit to offset the substantial transitional costs of dismemberment and the risk that users will lose the innovative product differentiation and other competititive benefits now being provided by the non-IBM mainframe companies.

While the undersigned companies have these very real concerns over the effcacy and feasibility of the dismemberment plan in the Antitrust Division's October, 1972 relief memorandum, the position of these four companies is that the merits of *any* ultimate relief plan, be it the Antitrust Division's or those of any of the four companies, cannot now be adequately evaluated.** Under the best of circumstances, the effective date of the measures imposed by way of ultimate relief is many years away, and during the intervening years the facts and circumstances which should dictate the type of ultimate relief that is both feasible and efficacious, *i.e.*, the industry structure and composition, the state of the technology, user needs, the position of the United States relative to other countries (including balance of payments and balance of trade considerations), and other domestic and international economic factors, may drastically change. It is for these reasons that we feel that the government should not attempt at this time to fix on a definite plan for ultimate relief, but rather defer the formulation of its final relief plan to a point in time when the controlling considerations are known or at least can be evaluated with much less uncertainty.

In spite of such difficulties in predicting future events, these four companies expect that consideration will have to be given to divestiture of some type and to divestiture and other relief being implemented on a world-wide basis.

V. CONCLUSION

It is the considered request of the parties to this Memorandum that the Department of Justice give due consideration to the collective positions expressed herein. We believe that the views of these companies deserve substantial weight because they represent computer-dedicated assets producing annual revenues of over $2,500,000,000. These four companies employ over 300,000 people, almost half of them directly involved in computer efforts; these companies are owned by over one quarter of a million shareholders. These companies are significant suppliers to the U.S. government and are major exporters. These companies are also the source of significant innovation in all facets of computer technology. With so much at stake, these companies are vitally interested in the efficacy and consequences of the relief to be sought against IBM.

It is obviously in the self-interest of these companies to remain viable and to grow in strength, but inasmuch as these four corporations represent a significant

*"Technological lock-in" arises from the close inter-relationships of hardware and software in a complex computer system and the close integration of the computer system with most users' operations. By making a change in suppliers uneconomical, this distinctive phenomenon of the computer industy ties customers to suppliers and lends itself to manipulation to maintain monopoly power by a dominant firm. The importance of the concept lies in the doubt that it casts on the efficacy of the plan in the Anti-trust Division's October, 1972 relief memorandum as a means to dissipate monopoly power. In most industries, such dismemberment would "automatically" accomplish a dissipation of power, but the peculiarities of the computer industry present a special set of problems.

**The Antitrust Division stated a somewhat similar position in its October, 1972 relief memorandum when it suggested (pp. 2–3) that the principal effort should be directed to ". . . achieving a fully developed record upon which to evaluate the future efficacy of this or other forms of relief."

share of what remains of the non-IBM segment of the computer-manufacturing industry, the increased vitality of these companies is also of paramount importance to the public interest.

Representatives of each of the companies stand ready to elaborate on the positions stated in this Memorandum and to work with the Antitrust Division staff in an effort to solve the complexities inherent in the ultimate relief question and to effectively address the issues involved in the interim relief concept proposed in this Memorandum.

Respectfully submitted.

Appendix A to October, 1973 Relief Position Paper of CDC, Honeywell, NCR and Sperry Rand

PROPOSED INTERIM RELIEF IN U.S. V. IBM

The following eight relief measures (including the three injunctions proposed by the Antitrust Division) are expressed only as general concepts. They are intended to be applicable world-wide.

I. The Government's Suggested Injunctions

The Antitrust Division's October, 1972 relief memorandum set forth interim relief recommendations to which we subscribe. In addition to the standard anti-scrambling provisions of section II of that memorandum, the government suggested the following injunctive provisions:

Interim Relief Measure No. 1: IBM shall not use bundled pricing.

Interim Relief Measure No. 2: IBM shall not engage in predatory or discriminatory pricing.

Interim Relief Measure No. 3: IBM shall not make premature announcements of its computer products.

Comment: These three remedies are noncontroversial, minimal provisions necessary to preclude IBM from direct, anti-competitive behavior during the interim period.

II. Remedies Providing Access to IBM's Patents, Know-How, Software, Product Specifications and Unique Products

The following injunctive provisions would provide rights to license IBM's patents, software and other know-how, to have disclosure of its product specifications and to buy its unique products on an OEM basis, all of which rights could, but would not necessarily, be extended indefinitely as part of the final relief.

Interim Relief Measure No. 4: IBM shall not refuse to license its EDP patents and EDP know-how, patentable and unpatentable alike (and, where it has the right to do so, sublicense its rights under the EDP patents and know-how of others) to all applicants on a reasonable-royalty, non-discriminatory basis. IBM shall afford such applicants reasonable assistance in understanding and utilizing such rights and information through plant visitation opportunities and other methods, the expense of which may be charged applicants on a reasonable, non-discriminatory basis, not to include the original cost of producing the know-how.

Comment: This provision would preclude IBM from using its strong patent and technical position to injure competition.

Interim Relief Measure No. 5: IBM shall not refuse to license, with the right to sublicense, its software products, including applications programs, to all applicants on a reasonable-royalty, non-discriminatory basis.

Comment: This provision would prevent IBM from using its dominant position in software to inhibit sales by competitors and to interpose itself between its competitors and their customers.

Interim Relief Measure No. 6: IBM shall disclose to other suppliers of EDP products having a legitimate interest in such disclosure, the complete product specifications of its EDP hardware, software and media products, including functional, interface, media and performance specifications, and also the applicable communications procedures, at the time of product announcement, or 24 months before the reasonably anticipated delivery date, whichever is earlier.

Comment: This provision would ameliorate the competitive advantage that IBM has by virtue of its control of *de facto* standards.

Interim Relief Measure No. 7: IBM shall not refuse to sell to original equipment manufacturers any EDP product, a substitute for which is not reasonably available elsewhere, to be incorporated in EDP systems produced by such manufacturers, at prices and with delivery commitments which enable them to effectively compete.

Comment: This provision is designed to eliminate the possibility that IBM could use a monopoly position in a new EDP product to hamper the competitors' sales of systems which depend to a material extent on such new product.

III. The Controlled Growth Remedy

The objective of this remedy is to preserve the *status quo* regarding IBM's market share pending the effective date of final relief.

Interim Relief Measure No. 8: IBM shall be subject to suitable measures to limit its growth to that of the market(s), or, preferably, less. Such measures should be based on data readily available to the Court.

The markets to which this interim relief measure should be applicable would be selected in light of the District Court's findings (before or after trial) as to the market definition and the scope of IBM's monopoly power. However, the markets to which this remedy would apply would not be confined to those found by the Court to have been monopolized by IBM. Rather, the remedy would be extended to the additional EDP submarkets which would require the protection afforded by this remedy, and also to the related markets for EDP products and services (such as communications, terminals and professional services) which are most likely to be the target of future domination by IBM.

IBM should be required to give priority to its then existing customers so as to diminish the number of new customers potentially "locked-in" to IBM equipment and thus "preserved" for the IBM successor companies.

Comment: As stated in the accompanying Memorandum, the philosophy behind this remedy is that it is the only sure way of preventing a complete domination of the industry by IBM during the period prior to final relief. The remedy would be applicable to the market(s) found to have been monopolized by the District Court, and also to the related product and service market(s) and sub-market(s) which would be particularly vulnerable to an IBM takeover if its expansion in principal market(s) were limited during the interim period.

Exhibit 6.—*CDC Memorandum—Report to U.S. Department of Justice Re: IBM Attempt to Monopolize and Monopolization of the Automatic Data Processing Industry*

In Re: International Business Machines Corp.

I. INTRODUCTION

A. General

The information compiled herein has been gathered by Control Data Corporation in response to anticompetitive activities of International Business Machines Corporation and its subsidiaries, including IBM World Trade Corporation and Service Bureau Corporation, hereinafter collectively referred to as "IBM". IBM, by far the dominant company in the field of automatic data processing, has been engaged in conscious and determined effort, intensified in recent months, to enlarge its U.S. and world-wide monopoly position at the expense of its much smaller competitors, and its practices have amounted to clear violations of the U.S. antitrust laws. Unless immediate and forceful action is taken to terminate the practices and to restore legitimate competition, severe injury to participants in the automatic data processing industry will result.

The material presented herein is the result of informal investigation by one small competitor and is limited by the resources available to it. Much of the detail which would be available through discovery in judicial proceedings, particularly from IBM, is therefore lacking. Also, because of the nature of the practices and the possible adverse effect upon sales efforts of Control Data, it has not been feasible to interrogate customers in most cases, although information has been obtained from customer sources wherever possible. Because of the consistency in the great amount of detail that has been gathered and the fact that on occasions where opportunity to corroborate has existed the information received has been subsantiated, it is believed that the great bulk of the information set forth is factually correct, notwithstanding the possibility that in isolated instances some fact may not have been accurately reported, some circumstance may have been misinterpreted, or some explanation may not have been made known.

The material set forth in this Introduction is merely for the purpose of facilitating an understanding of the setting in which the anticompetitive practices take place. The descriptions of the market, of the equipment involved and of the trade abuses themselves have accordingly been condensed and simplified.

B. Description of the Industry

The industry involved is automatic data processing ("ADP"), which utilizes both electro-mechanical and electronic equipment for the processing of various types of information, or data. Historically, the base of the ADP industry was electro-mechanical ("tabulating" and "punched card" equipment), which has been supplemented, in recent years, by electronic digital computers for electronic data processing ("EDP"). Thus, many modern computing systems have evolved as a combination of one or more central electronic computers operating with a variety of electro-mechanical peripheral equipments, including readers and punches for punched cards and punched paper tape, printers or tabulators of various speeds, magnetic discs, drums and tapes, optical character readers, etc. The equipment is used for processing data, such as routine clerical, inventory and accounting information; for solving mathematical and scientific problems; for solving complex problems in areas such as production and profit optimization; for industrial process control; and for space vehicle launch control. The principal part of this Report relates to the electronic digital computer systems segment of the data processing industry, although the technologically-earlier tabulating (or punched card) part of the industry is a significant part and continues to have heavy impact upon the electronic computer industry.

The computer industry has experienced an extremely high rate of growth and very rapid technological development throughout its brief lifespan, from the early 1950's when large, slow, vacuum tube computers were used, to the present, with extremely fast, "solid-state", transistorized computers far exceeding in speed and capacity the earlier models of computers. To illustrate the rapid change in technology, the most powerful computer in general commercial use during 1952-55 was the Sperry Rand Univac I Computer, followed shortly by the Univac II. Of over 80 of such computers believed to have been delivered through 1960, when the last Univac II was delivered, only 34 were still in use at the end of 1964. By the end of 1964, the most powerful computer in use was the CONTROL DATA 6600, which provides execution speeds of over three billion instructions per second and possesses over 2,000 times the power of Univac I and II. Control Data's leadership in extra-large machines was acknowledged by Mr. Thomas J. Watson, Jr., IBM's chief executive officer, at a Shareholders' Meeting in April of 1964.

The electronic computer industry started during the years of WW II, when some elementary computers were built for defense applications. It grew slowly after WW II to the point where by 1952 perhaps one hundred small electronic computers were installed in the U.S., a few of which had been installed by IBM. By the end of 1956, a total of 810 computers had been installed in the U.S., having a cumulative value of $83 million. The growth of the electronic computer industry has been very rapid since that date, to the point where over 25,000 general purpose digital computers were installed in the U.S. at the end of 1965, plus an estimated additional 10,000 computers outside the U.S. In addition to these figures, there are several thousand special purpose electronic computers installed. During 1965 alone, it is estimated that there were over 10,000 new computers installed, an increase of approximately 30 per cent over the total number of computers installed as of the end of 1964. Thus, the combined sale and lease base of the overall industry continues to grow at the rate of approximately 20–30 per cent per year, a rate which has been maintained for several years. Industry sources generally believe that the total market, U.S. and world-wide, will continue to grow at the same rates in the predictable future, with no plateaus in sight. Because of the large number of leased systems, however, the reported income (as in the case of IBM) does not immediately show up as such a large rate of increase.

C. Market Shares

IBM has long been the dominant company in the automatic data processing industry. As alleged in the Complaint, Civil Action No. C-72-344, Filed January 21, 1952, *United States of America, Plaintiff, v. International Business Machines Corporation, Defendant*, IBM then owned 90 per cent of all tabulating machines in use in the United States, and was leasing more than 100,000 electrical tabulating machines to more than six thousand lessees at an annual rate of approximately $100 million.

Since 1952, IBM has significantly increased its base of tabulating machines, by also building on and adding an extensive line of more advanced electronic digital computers. IBM's annual revenues have meanwhile grown to a 1965 amount of $3,572,824,719.

IBM, as a matter of strict policy and practice, is highly secretive, and does not disclose the total number of its computer installations to the trade press, industry associates, etc.; therefore, exact data regarding IBM's current share of market (based on the equivalent original-sales-value of installed machines, whether sold-outright or leased) is very difficult to ascertain, except by equipment counts as revealed by known customers of IBM (although most other industry members periodically publish their census of installations). Total "Industry Data" as reported by industry analysts, is, therefore probably subject to variation on the conservative side simply because it is impossible for any outsider to locate all of the IBM installations. Under these circumstances, it is generally estimated that IBM's share at the end of 1965 of the electronic computer ("EDP") segment of the market was at least 70–80 per cent and when the electro-mechanical tabulating systems part of the business is added to this, IBM's share of the total automatic data processing industry is probably well above 80 per cent of all ADP installations, both world-wide and in the United States. IBM reports that it continues to lease 80–90 per cent of its equipment. IBM has reported an average of 17 per cent increase in revenues per year, compounded annually, since 1952. Its aggregate revenues for 1964 having been $3,239,359,581, IBM reported its consolidated earnings for 1964 at $431,159,766. IBM recently preliminarily reported 1965 revenues of $3,572,824,719, up $333 million or 10.0% over 1964, with earnings of $476,902,490, up 10.5% over 1964 earnings.

The cumulative sales value of computers installed throughout the world by the end of 1965 was about $11.2 billion, of which about 75 per cent were installed in the U.S. IBM has reported that, in recent years, the operations of its U.S.-controlled foreign operating company, IBM World Trade Corporation, have been increasing at about twice the rate of IBM's U.S. operations, with the expected result that by the year 1970, IBM's U.S. and foreign operations will be about equal. Today, IBM's U.S. operations comprise over 2/3 of IBM's total.

As of the end of 1965, no competitor of IBM accounted for as much as 8 per cent of the total market, the largest being Sperry Rand Corporation, followed by several smaller competitors, including Control Data, which possessed about 4 per cent of the market. In recent years, the intense competition, particularly from IBM, has caused most of IBM's competitors to operate at a loss, frequently quite severe. As a result, a number of competitors, both in the U.S. and abroad, have been compelled to sell out, merge or otherwise cease competition, e.g., Underwood, The Bendix Corporation, General Mills, Alwac, Autonetics, General Precision, Compagnie de Machines Bull of France, Zuse K.G. of Germany, Olivetti of Italy. A descriptive account of this situation contained in the "Washington Post" on July 8, 1965, is attached as Appendix 1.

The fact that 70–80 per cent of the total computer systems installed in the United States and world are IBM systems makes it necessary, in order to attain a significant position in the market, that other computer manufacturers design their equipment and the programs which operate them to be compatible with IBM equipment and programs. Most computer users presently have (or have ordered, or probably will at some future date order) IBM equipment, and these customers have spent or will spend enormous amounts of money to gather, organize and exchange the data to be processed by these systems, and to develop their computer programs to operate their total systems which often comprise many inter-related computers. They will not consider acquiring a second manufacturer's equipment unless and until such data and programs, or substantial portions thereof, can be used on the other manufacturer's equipment. Further, they, as well as customers acquiring computer systems for the first time, frequently wish to exchange data or programs with other computer users, which users generally have IBM equipment. Such exchange is feasible only if the equipment ("hardware") and programs ("software") to be acquired by the customers are functionally compatible with that of the other party to the proposed exchange.

Automatic data processing accounts for about 80 per cent of IBM's total revenues and 90 per cent of Control Data's revenues. No other company with a significant position in the industry receives as much as 10 per cent of its revenues from such source, except Sperry Rand, which receives less than 20 per cent; General Electric and RCA receive only 2–3 per cent of their income from computers. Therefore, IBM's anticompetitive practices, while wrongful and injurious to all its competitors, are particularly injurious to its smaller competitors including Control Data, who rely on the data processing business for

the majority of their income and earnings, and who do not have large sustaining incomes from such as color TV and steam turbines to carry them through competitive crises.

The growth of Control Data Corporation (hereinafter referred to as Control Data) in the industry since Control Data's formation in 1957 was initially the result of careful concentration in specialized areas, particularly scientific, and the avoidance of an attempt to enter into general competition with the very much larger companies in the industry. The technological excellence of Control Data's equipment, coupled with careful marketing effort, enabled the company to gain an initial foothold in the industry. The subsequent design, engineering and manufacture of large-scale electronic digital computers which far exceeded the capabilities of competitive equipment, along with the acquisition of several smaller companies in the industry, have aided Control Data in expanding its total revenues from $19,783,745 in 1961 to $160,473,162 in 1965 (in each case to June 30, when the company's fiscal year ends). Most recently, Control Data's growth and earnings both in the United States and abroad have been greatly inhibited by the anticompetitive practices of IBM as described in this Report.

D. The Extra-Large Computers

The so-called "extra-large" or "giant" computers deserve special mention because of their importance—their enormous capacity and great speed, their ability to handle vast quantities of data and solve tremendously complex problems, their indispensable role in the nation's space and defense efforts, and the sheer dollar investment in each such computer or system. These giant computers are also significant because of their "time-sharing" potential, that is, the capacity for simultaneous computer use by several users, frequently at locations some distance removed from the central computer. Because of their importance, IBM has centered much of its anticompetitive activities about these computers and has called upon its vast financial and manpower resources in a powerful drive to capture the extra-large computer business and to eliminate competition with respect to their manufacture and sale.

Although there is no generally accepted classification of "extra-large" or "large-scale", computer users and manufacturers agree upon the use of "powerful" or "power" as an apt description of magnitude, "power" being used to reflect the combination of machine speed and capacity. The most powerful computer presently in use is agreed by all to be the CONTROL DATA 6600 (See Appendix 2 for descriptive material), which provides execution speeds of 3,000,000 instructions per send. The purchase price for a typical 6600 computer is approximately $5,000,000 to $6,000,000. The first 6600 was delivered in September 1964 and, as of January 1, 1966, a total of six had been delivered. The CONTROL DATA 6000 Series also includes the smaller 6400 the first of which is expected to be delivered early in 1966, and the more powerful 6800, which is scheduled for first delivery in June 1967.

While several other "large-scale" computers have been offered commercially by manufacturers other than IBM and Control Data, these are far less powerful than the existing CONTROL DATA 6600, and are generally considered to be in a smaller class, merely "large-scale" rather than "extra-large". (Late in 1965 Sperry Rand, Burroughs and General Electric announced extra-large computers, but these have not been a considerable factor as far as competition to date has been concerned). IBM made a much belated entry in the extra-large computer market. Although it announced its new 360 Series of computers on April 7, 1964, (a so-called "third generation"), the then-announced new line lacked an extra-large computer. IBM nevertheless attempted to interest customers in such a computer and began to offer a changing series of computers variously known as 360/90, 360/92, 360/95, and more recently 360/85. From time to time, subsequent to April 7, IBM announced new or varied computers (or modifications of prior computers) in the 360 Series. Many of these are believed to have been nonexistent, as was the Model 92. The Model 92 was described by IBM as providing execution speeds of 3 million instructions per second, making it comparable to the CONTROL DATA 6600. The 360/92 was offered for sale for approximately $6,000,000 to $9,000,000. No 360/92s have been delivered, and the trade press has recently stated that IBM will no longer have the 360/90 models for sale. Whether these are being replaced by the Model 360/85 which has been veiled in secrecy or the Model 360/91 which was formally announced on January 18, 1966, is not known. The very recent report in the January 21, 1966 WALL STREET JOURNAL (Appendix 3) completes the full circle of confusion.

E. The Wrongful Practices

The remainder of this Report is devoted principally to elaborating upon the unlawful practices in which IBM has been engaged over the years. IBM has intensified the practices markedly as a result of the impact of the CONTROL DATA 6600 upon the market. When IBM found itself without a large-scale computer to offer as a competitive alternative to the 6600, all of the stops were pulled and a frantic, no-hold-barred campaign was ordered at the top level of IBM management. IBM accelerated the announcement of the 360 Series. Top management was reorganized, one key executive being reassigned with instructions to "stop Control Data".

Before the 360 Series was announced and with the effect of seriously delaying customer procurement of competitors' equipment, IBM began "leaking" information about its forthcoming "third generation" of computers (which IBM said would render obsolete existing computers). After announcement of the 360 Series, it became apparent that many computers in the series were non-existent. IBM made change after change in models and in specifications, quoted unrealistic delivery dates, and deferred delivery dates that had been scheduled. New computer "models" replaced the recently-announced models, even when the earlier-announced models had been ordered by customers, and obviously false claims were made about machine capabilities. How IBM used its "Paper Machine" to injure competitors and in an attempt to increase its monopoly is described in the section following this Introduction.

IBM directed extra heavy attention in its Paper Machine campaign to educational institutions and scientific organizations, the simple explanation for this being that these are the foremost potential customers for extra-large computers. In addition to being a prospective customer itself, a university has substantial and unique strategic, prestigous and actual influence on other potential customers, because compatibility among computers assumes considerable importance when the users exchange computer programs, a frequent occurrence among scientists. Also, scientists, students and trainees at a university acquire a strong predisposition toward using the same manufacturer's line of computers in their later employment.

Most important, there are a few key educational institutions, such as Massachusetts Institute of Technology, Stanford University, University of California, and Carnegie Institute of Technology whose mathematicians and other computer personnel are particularly skilled and advanced in computer usage. Manufacturers are extremely anxious to place equipment at these institutions because their personnel will then be available to the manufacturer to criticize and debug the equipment and develop new and imaginative programs or software for operating it.

IBM embarked upon a campaign, perhaps unequalled in the history of competition, to block Control Data from marketing more of its extra-large computers, the only ones actually available and in use, to the university market, using the IBM Paper Machine, "bait and switch" tactics, threats, disparagement, "buy-backs" and discriminatory discounts. This resulted in extreme confusion in the market place and the immediate loss of much otherwise profitable business to Control Data.

IBM openly proclaimed that it was not going to lose any more "university business" and customers were so advised. Also, IBM's chief executive officer, Thomas J. Watson, Jr., in December of 1964, stated that his company "is going to compete at whatever price level is necessary to maintain our position in the industry . . .". (See Appendix 4 attached for a more complete description of this quotation taken from the December 1964 issue of DATAMATION magazine.) The discount effort, controlled by IBM top management, was of such magnitude that a separate part of the pricing practices section of the Report is devoted to its description. Despite giving lip-service to a standard "educational" discount, IBM gave varying discounts, from 20% to 100%, to various institutions, the amounts being tailored to whatever appeared necessary to beat out Control Data. Greatest discounts were given in the case of large computers to the most influential institutions and to universities which had large money contracts with the United States Government. Purchasers of small computers or other equipment received little or no discounts. This program severely injured competition. Should it be continued, IBM will drive all competitors from the market.

Because of its great size and dominant position, IBM controls the market structure in the data processing industry. If IBM induces customers to lease rather than purchase equipment, other manufacturers must also lease if they

wish to be competitive. IBM has encouraged leasing of computer systems in the following ways:

1. Rapid changes by IBM in model numbers, thus preying on customers' fears of rapid technological obsolescence, have made many customers unwilling to invest large sums of money in computer purchases, especially when these new models have improved performance/price ratios.

2. IBM has steadily reduced the cost of leasing in relation to the purchase price of its systems by doubling maintenance charges on purchased computers over the last three years without correspondingly increasing rental rates (see Appendix 5) and has provided additional incentives to lease in the form of reduced rental for extra-shift use (explained in Appendix 6) and allowance of rentals paid for one computer as a credit on the subsequent purchase of other equipment (see Page 27 infra).

The ultimate effect of these practices is identical to the effect of the practices attacked in the 1952 Government suit against IBM. Because many customers have felt compelled to lease, IBM's competitors have been required to overextend themselves financially in funding an increasing percentage of leasing. IBM, on the other hand, with its enormous financial resources, can easily afford to postpone revenues and profits over a longer period.

On the other hand, when leasing is not to the competitive advantage of IBM, as where IBM is supplying equipment to its competitors, the pattern is reversed and customers are required to purchase. Thus with the market trend toward leasing firmly established and growing, IBM very recently altered its policy so as to require its competitors to purchase. These competitors are required on many occasions to provide compatibility with IBM systems and, therefore, to offer IBM equipment as part of their own systems. (The equipment may be of a type manufactured only by IBM or it may be desired as a result of IBM's hardware, software or programming activities). Competing manufacturers who need IBM equipment as part of their systems are now required to make substantial capital outlays even though their own customers are demanding to lease the same equipment.

The Miscellaneous Unfair Trade Practices section of this Report contains a brief description of IBM's "software" (computer programs or instructions) efforts, by which IBM ties its customers to its entire line of computers through making available to them at little or no expense vast "libraries" of programs helpful for facilitating greater utilization of computers at reduced cost. Having, during the industry's lifetime, by virtue of its market dominance, been in the position of establishing de facto standards, IBM now seeks to set new standards and to exclude competitors from the formation of these standards and to delay competitors from meeting the standards. IBM has also changed equipment standards with the same anticompetitive effect. The Miscellaneous Unfair Trade Practices section also describes IBM's anticompetitive activities in connection with its service bureaus and patent policy.

The foregoing practices are only briefly summarized at this point, as an aid to understanding the overall competitive situation. The details are set forth in the following sections.

F. Appropriate Relief

IBM's practices have substantially injured all competition in the computer industry and have substantially impaired the likelihood that other members of the industry will be able to compete effectively in the future. As already indicated, several firms in the industry have gone out of business or sold the computer part of their operations. Moreover, we are confident that no major competitor, despite public relations efforts to convey a contrary impression, is able to make a profit from computer sales. Although Control Data was able to make a profit for several early years in its short history, its most recent financial statements show virtually no profit and reveal the repressive effect of IBM's anticompetitive practices. Immediate and effective relief is imperatively needed to create conditions in the industry which will permit other producers to challenge IBM's dominance. Indeed, if IBM's practices are not enjoined, it is highly unlikely that the few competitors left in the industry will remain viable, or that they will be able to engage in the research and development and marketing endeavors which are the lifeblood of their continued existence.

Damages are of course recoverable in a private action but these cannot fully compensate for the severe and long-term injury to competition which IBM's practices have wrought. Prior efforts at restraining or confining IBM's anticompetitive efforts have demonstrably failed, such as civil suits by competitors

and the Consent Decree entered in 1956 following a civil suit brought by the Justice Department. Notwithstanding these prior suits, the Consent Decree and various investigations, IBM top management consciously resolved to proceed with the present course of conduct. In fact, in April 1965, Thomas J. Watson, Jr., Chairman of the Board of IBM, stated in substance, "We have been living under the letter of the Consent Decree until now. We are going to be competitive in the large-scale area."

With such background, it is readily apparent that the only effective remedy is the fragmentation of IBM into a number of smaller independent and unrelated companies incapable of wreaking havoc on the scale of such a gigantic corporation as IBM. The concluding section of this Report is accordingly devoted to appropriate relief, not only dismemberment but additional forms of relief.

II. IBM'S ANTICOMPETITIVE PRACTICES

A. The 360 Story

IBM announced its 360 Series, a group of six supposedly completely compatible systems, to the trade on April 7, 1964. Since that time, IBM has extensively advertised and aggressively marketed these systems (or systems subsequently announced to replace them). We believe that both the original announcement of the 360 Series and IBM's subsequent marketing program operated—and were intentionally designed—to delay sales of existing computer systems by IBM's competitors until such time as IBM could correct deficiencies and incorporate more compatibility in the systems it had been marketing. More specifically, we believe that a thorough investigation will produce evidence that IBM employed the following tactics. IBM announced its 360 Series to the trade before the Series' technological development had been accomplished in order to delay—and ultimately prevent—purchases of its competitors' computers; after the original announcement, IBM frequently changed model numbers, quoted inaccurate and misleading delivery dates, promoted and sold computers which had not been developed and which IBM had no intention of delivering—all to confuse purchasers, to disguise the prematurity of its original announcement, and to delay—and ultimately prevent—purchases of its competitors' computers.

1. The Computer Industry

As would any sensible monopolist, IBM hesitated to introduce innovations in computer technology. By the early 1960s, however, IBM became seriously concerned that its commanding position in the industry might be threatened: customers, scientific and business, were beginning to require more powerful computer systems; IBM's small competitors, notably Control Data, seemed prepared to meet the demand; IBM's effort, in partnership with the U.S. government, to develop a "large-scale" system (the "STRETCH" project) as a standard product had been unsuccessful. IBM, aware that it would be able to retain its share of the market only by developing new and better computer technology quickly, established a task force—"Project Spread"—to examine current technology and to recommend a new line of computers. The "Spread" report, issued in January, 1962, suggested a series of five compatible computers. The original design specifications for these computers, designated tentatively as the 8000 Series, provided for "printed" circuits and predicted that the computers could be delivered during the third quarter of 1963. After some internal dispute it was decided that the performance/price ratio of these computers would be inadequate with printed circuitry; the decision was made to use a different design utilizing "chip" circuitry. Since these design modifications meant that the new computers (now the 360 Series) could not be delivered before the third quarter of 1965, company officials decided in 1963 to introduce stop-gap computers to retain IBM's position until its technological problems could be overcome, and as a way of encouraging customers not to purchase competitors' products during the development period of the new Series. IBM had every reason to be confident that delaying competitors' sales would be sufficient to protect its position in the market; once the technological gap is closed many computer purchasers will prefer IBM simply because they are confident that IBM will never be forced out of the industry.

Thus, IBM had a substantial interest in delaying sales by its competitors for at least a two-year period. Any IBM effort to accomplish such delays would be aided by facets of competition in the computer industry of which IBM was certainly aware. When the industry leader announces a new product line, prospective purchasers cannot simply ignore the product—even if another com-

pany is currently delivering a product which might be just as good or even better. Prudent purchasers must delay at least long enough to study and compare the specifications of the new product. Consider, for example, the prediction in ELECTRONIC NEWS one week after the 360 Series was announced (April 13, 1964, page 1): "Sales of computers would virtually dry up until customers had analyzed the capabilities of the new computer generation, but once this is done sales would jump."

Computer purchasers are especially likely to delay when a new series of compatible systems is announced. Compatibility features are prized by many computer users. A company may require a small computer for some tasks and a much larger one for others: the company would naturally want to use programs designed for the small computer in the larger system's operations as well. Thus, Standard Oil Company of California has adopted the following policy for computer purchases:

> All systems used will be totally compatible, both upward and downward, so that as the work loads change in given areas equipment can be changed to meet these needs.

Compatibility features are also important to a company planning its initial investment in a computer. Many companies purchase a small machine and "grow" into a larger computer; significant savings can be achieved if programs developed for use with the initial computer will not have to be scrapped when a larger one takes its place.

Finally, IBM was aware that its sales would not be seriously injured if customers learned later that IBM had bought technological development time by marketing "paper machines". Once committed to an IBM computer, a purchaser is unlikely to cancel his order even if the computer is not delivered as promised. Indeed, we are informed that all IBM salesmen are trained to bend every effort, as soon as the customer places his order, to get the customer to start spending money; the purchaser's computer operators are sent to IBM's training school; IBM instructors begin to train the purchaser's programmers; the purchaser's executives are invited to IBM's executive training school; the purchaser is encouraged to begin to design the room or building to hold the IBM computer when it is delivered. Most important, IBM encourages the purchaser to begin to develop programs. All of these preliminary steps are expensive; it is common in the industry to estimate preliminary expenses as equal to the cost of the system. And, of course, the larger the computer, the greater is the initial investment. Under these circumstances, many customers would and do hesitate to cancel their contract with IBM a year or two after the initial order simply because IBM has slipped delivery—possibly wasting their initial investment and possibly incurring additional delays. Note, for example, the following story reported in DATAMATION (December, 1965):

> IBM will pay LA city an estimated $20–30K penalty for a three-month delivery delay of third level software on the 360-30F due in mid-December. With $300K invested, the City didn't feel justified in reopening bids to other vendors, will accept $17K plus $100 a day until everything is in, with no rent until it is all working.

IBM's financial condition is such that it need not be concerned about such liquidated damages—so long as competitors are being deprived of sales.

It is appropriate to point out that delaying competitors' sales would have incidental advantages for IBM. Any producer with limited capital is at a considerable disadvantage in the computer industry. Large sums must be spent on research and development; production facilities and each unit produced are expensive. Extensive bank credit is a necessity—but is available only if the borrower's product, as measured by his success in marketing it, warrants the risk. If IBM can delay a competitor's sales, the competitor's financial position may be significantly injured.

2. IBM's Methods

(a) *Announcement of the 360 Series.* The 360 Series was designed and developed in an atmosphere of haste and concern that customers might turn to competitors' products before 360 computers could be marketed. We believe that the Series was announced in the same atmosphere and with the purpose of delaying sales by IBM's competitors.

For some time prior to IBM's official announcement of the 360 Series, IBM salesmen advised customers, in situations where they encountered difficulty in

selling an existing computer and were fearful of a competitor breakthrough, that the customer should forestall any immediate procurement because announcement of a new "third generation" of computers was imminent. The "rumors" of the 360 Series' imminence were obviously inaccurate; indeed, the Series was publicly announced before models in the Series had undergone normal company developmental testing. We are reliably informed that, until 1963, IBM subjected new products to exhaustive testing at three or four stages of their development. In what was called the "A" test, a prototype of the product was constructed to determine whether it met specifications; the "B" test followed re-design and correction of the prototype. If the product passed the "B" test, a manufacturing run of the product was arranged; units from this run were then subjected to the "C" test. IBM normally delayed announcement of a new product until it had passed at least the "B" test. The 360 Series, however, was treated atypically by IBM. Although some standard components of the lower performance computers in the 360 Series had passed the "B" test by April 7, 1964—when the prevalent trade "rumors" were for the first time publicly confirmed by IBM with great fanfare—the basic overall system had not been tested. Moreover, IBM had originally planned to announce individual models of the 360 Series one at a time, as they reached the appropriate developmental stage. It was obvious, however, that announcement of a complete series of compatible systems would maximize the delay of customer orders. After substantial disagreement within IBM, a decision was made to announce all System 360 models on April 7, 1964; in fact, one IBM executive was demoted, we are informed, because he disagreed with this decision.

IBM's behavior after the April 7, 1964 announcement provides evidence that the 360 Series had not been completely developed when originally announced and that IBM was anxious to hide this fact from its customers. One device adopted by the company was frequent announcements of new models and withdrawal of original, and even subsequently announced, models in the Series. Often, supposedly new models have been near-copies of unperfected old models with slightly modified performance and/or price specifications. These announcements are described in greater detail below. It sufficies here to quote a WALL STREET JOURNAL reporter's reaction to IBM's press release of April 26, 1965, which announced the addition of three new models for the 360 Series and the cancellation of five previous models (two of these had been announced only the month before): "Was its announcement on April 7, 1964 premature and made for competitive reasons before development was completed?" (The WALL STREET JOURNAL, Monday, April 26, 1965, page 4, column 1; the entire article is attached as Appendix 7.) IBM's public response to the widespread speculation, of course, was an emphatic denial.

Another device IBM adopted to hide from its customers the fact that the 360 Series was announced prior to completion of its technological development was frequent modification of delivery schedules. Although the original delivery schedules provided for lengthy delays, in December, 1964, IBM announced accelerated delivery schedules "made possible by accelerated production at IBM manufacturing facilities in response to customer demand". (BUSINESS AUTOMATION NEWS REPORT, December 7, 1964). Nine months later, however, the company was singing a quite different tune. In October, 1965, the Chairman of IBM's Board of Directors announced that delivery schedules were being postponed for from two to four months, this time attributing the delay to "problems in building up the rate of production as rapidly as necessary to meet the unprecedented demand for the new equipment." (WALL STREET JOURNAL, October 27, 1965, page 32, column 1).

In fact, we believe that IBM never had the ability, or the intention, to abide by its original delivery schedules. We are informed that, prior to the 360 Series, IBM scheduled manufacturing and delivery of computers in relation to orders received. Delivery dates were widely disseminated internally; every salesman knew almost instantaneously the probable delivery date of any system he was trying to sell. In addition, IBM had meticulously programmed its production control. Illustrative of IBM's ability to predict delivery prior to the 360 Series is the experience at the company's Rochester, Minnesota plant in 1962; approximately 11,000 units were shipped from the plant, and only one was shipped after the specified delivery date—that one was late by only six hours!

The evidence available compels the inference that IBM decided to announce a nonexistent series of computers in order to prevent, or at least delay, sales by its competitors—all to retain its dominant position while overcoming its marketing and technological handicaps.

(b) *Marketing the 360 Series.* The 360 Series, as originally announced April 7, 1964, included the following models: 360/30, 360/40, 360/50, 360/60, 360/62 and 360/70 (higher postscript numbers in the Series denote machines of greater computing power). As we have indicated, IBM's subsequent behavior was designed to mask the fact that the Series contained many "paper machines" as of the announcement date. In addition, the companys marketing tactics were designed to cause confusion among customers and further delay of competitors' sales—giving IBM more time to overcome technological handicaps. These tactics were successful.

We have already mentioned two of IBM's favored techniques: (1) frequent changes in delivery schedules, and (2) continual announcements of new models and cancellation of previous models even after orders have been taken for them. We have attached as Appendix 8 a chart indicating the model number changes and their dates, and a detailed description by Auerbach Associates, an independent analyst of computer systems, of changes in the 360 Series following April 7, 1964. There is every reason to believe that many of the model numbers introduced after the original announcement were "paper machines", some of which IBM never intended to produce. Many of the new models, for example, were supposedly time-sharing systems, which would require design modifications in the basic 360 main frame. It is believed that at the time these were announced, their development had not even progressed as far as that of the basic 360 System at the time it was announced.

In individual competitive situations as well, IBM marketed "paper machines" to delay and ultimately prevent sales by its competitors. In August, 1965, for example, IBM was trying to sell its 360/30 model to Aluminum Corporation of America in competition with Control Data's 3100 System (which was somewhat higher priced). When Alcoa requested comparative "benchmark" tests of the two systems, IBM's salesmen indicated that the test would have to be run on the 360/40, a more expensive system. Control Data ran the test successfully on the 3100. The IBM salesman then recommended a 360/44, which had not yet been announced, claiming that the system was three times faster than the 360/50, a more expensive system, but with a lease price between the 360/30 and the 360/40. Public announcement of the 360/44 was not made until a week later; at the time of the negotiations with Alcoa, IBM's Pittsburgh office had no knowledge of the 360/44 System—personnel from the Cleveland office were sent to make the presentation. Alcoa ordered the 360/44 to be delivered in January, 1967, and agreed to accept the 360/30 as an interim system. Thus, IBM was able to prevent Control Data's sale of an existing system with better performance and a higher performance/price ratio than IBM's announced system and gain at least a year and a half of additional development time—simply by creating a new model number.

The purposes underlying IBM's marketing strategy are most clearly seen in connection with the extra-large system market—a market in which IBM most feared losing orders because of Control Data's competition. The original 360 Series did not contain any extra-large computers; and Mr. Watson admitted at a shareholders' meeting in April, 1964—following announcement of the 360 Series—that IBM had no computer as powerful as Control Data's already-announced and soon to be delivered 6600. In August, 1964, IBM described to the trade the 360/90 (or /92 or /91 or /94 or /95—all of which numbers IBM salesmen have referred to). Although no design specifications, price or delivery dates were announced—supposedly because the system was to be built to each customer's individual specifications—the 360/90 was originally represented by IBM as a computer which would directly compete with Control Data's 6600. There is hardly any question that customers who gave IBM letters of intent for the 360/90 group computers would have purchased Control Data's existing 6600—the only existing extra-large computer—had it not been for IBM's "competition". The belief was always widespread among competing producers and many customers that the 360/90 group, although IBM was marketing the system, had never, in fact, been designed. The December 15, 1965, issue of COMPUTING NEWSLINE recently confirmed this industry rumor by reporting "IBM dropout of the supercomputer market . . . No more orders will be taken and no proposals submitted for the 360/90, /91 or /92. It is expected that three firm orders on hand will be filled while letters of intent will be cancelled . . .". To itensify the confusion, on January 18, 1966, IBM formally announced the 360/91J, /91K and /91L, and on January 21, 1966, the WALL STREET JOURNAL announced as apparent reversal of the COMPUTING NEWSLINE report of December 15, 1965 (see Appendix 3). The WALL STREET JOURNAL article did little to clarify IBM's plans,

failing to indicate which of the many models announced from time to time in the 360/90 group are in fact to be marketed. By stating that the Model 360 75 is the "next most powerful System 360 computer" the article implied the withdrawal of the recently reported 360/85. Failure to mention the 360/92, which for many months apparently was IBM's prime competition for the CONTROL DATA 6600, leaves the industry in the dark as to whether the 360/92 is still a part of IBM's product line. By vigorously marketing non-existent and possibly never to be produced computers, and by keeping the market in constant confusion as to its actual intentions, IBM has been able to deter sales by Control Data and thus seriously injure its financial strength as a competitor.

IBM's plans for blanketing the extra-large computer market following solution of its technological problems become clear when IBM's "bait and switch" sales technique is considered. "Bait and switch" tactics have been most prevalent in competition for sales at the upper end of the 360 Series—where IBM's technological disadvantages vis-a-vis Control Data have most seriously threatened IBM's market position. In using this technique, the IBM salesman secures a contract from an extra-large computer customer by bidding a 360/92 at a very low price; after a suitable interval, IBM seeks to convince the customer to purchase, instead, one or more of the lower end models—models more likely to be developed and eventually produced. In the NASA-Goddard procurement, for example, IBM was awarded a contract for a 360/92 after tape-recorded presentations by several producers. Within six weeks, we are informed, the IBM salesman had begun to make rounds at NASA-Goddard trying to convince personnel of the computer facility staff that they should accept a different system. Evidence is available of a number of similar incidents.

We are convinced that a thorough study of IBM's files would uncover additional evidence that IBM decided in 1964 to prevent sales by its competitors at all costs; one method the company adopted to pursue that course was to promote and take orders for undeveloped computer systems, some of which IBM never intended to develop. Other methods adopted by IBM to accomplish these purposes—including disparagement of competitors' products, establishing prices which discriminated against the most competitive types of computer systems, giving special discounts which operated to "lock-in" lessees of IBM equipment—are explained and documented in succeeding sections of this Report.

B. IBM prices its products so as to lock in its existing customers, cuts prices to exclude competition and refuses to lease necessary equipment to its competitiors.

IBM's unlawful pricing practices fall into two general categories, pricing to deter customers leasing its machines from replacing such machines with those of a competitor, and price cutting and other price manipulation to forestall competition. While information on IBM's costs is not available to Control Data, it is reasonable to infer from the known facts that in certain of the situations described below IBM also was selling at a loss. This section will also describe another unlawful practice by which IBM seeks to injure its competitors—refusal by IBM to lease to competitors certain kinds of equipment not manufactured by competitors which the competitors require for computer systems to be leased to customers.

Although most of the examples of pricing practices set forth below occurred in the United States, it is believed that substantially the same practices by IBM are prevalent throughout the world and are seriously hindering competition with IBM for foreign customers as well as domestic.

1. Deterrence of Replacement of Leased IBM Machines with Competitors' Machines

IBM recently has adopted two policies applicable to customers renting its machines which have the effect of "locking in" such customers by making it substantially more expensive for them to replace those machines with competitors' machines than with IBM machines. The impact of these policies in the market place can only be fully appreciated when it is realized that through IBM's conscious effort approximately 80% of the total IBM equipment acquired by customers is leased rather than purchased.

(a) *Conversion Rental Plan.* The conversion rental plan, adopted by IBM in about May of 1965, is available to any customer leasing IBM equipment who determines to replace it with IBM 360 Series equipment. The plan is not available if the customer elects to replace IBM equipment with that of another manu-

facturer. Under the plan, upon delivery of the new IBM equipment, the customer is allowed to retain the old IBM equipment for a four-month period, during which it pays only 10% of the normal rental on the old equipment. Payments by the customer on the new equipment begin when it has been installed and is operational, except in the case of the federal government which is permitted a thirty-day acceptance period before payments begin. Prior to institution of the conversion rental plan, customers ordinarily paid full rental for old equipment so long as it remained installed.

IBM's competitiors are unable to counter this discount, which practically forces many IBM customers to reinstall IBM equipment regardless for their desire to acquire other equipment. Since its competitors lack IBM's massive capital and surplus, they simply cannot afford to pay 90% of the customer's rent to IBM so that the customer can have a familiar system in operation while computing load is being converted to the new system. In addition, a customer may be loath to change to a competitive system because of the fear that IBM, as it has on at least one occasion, may refuse to allow the customer to retain the old computer, even at full rental, until the new computer has been installed. Adoption of this plan by IBM at a time when, as discussed elsewhere in this Report, IBM had become very concerned that its monopoly position was being threatened evidences that the purpose of the plan, as well as its effect, was to prevent its customers from installing competitive systems.

While not a part of the conversion rental plan and offered selectively by IBM in only certain competitive situations, it is appropriate to mention here three analogous devices by which IBM has hindered competition. There are indications that IBM has permitted some customers to retain leased IBM equipment completely free—without even payment of 10% of normal rental—during conversion to new IBM equipment. Moreover, old equipment has, on occasion, been retained by IBM's customers without payment for various periods of time after conversion to new IBM equipment is completed. Finally, in recent months, coincidental with IBM slipping deliveries on its 360 Series computers, it is believed that some customers have been permitted to pay 10% of the normal rental (or possibly even less) beginning with the date the new equipment should have been installed by IBM, even though installation was delayed.

(b) *Transferable 360 Series Purchase Credit.* IBM also is offering to at least some customers renting 360 Series computers an arrangement whereby a portion of the rentals paid by a particular customer for its rented 360 computer can be applied against the purchase of any other IBM computer in the 360 Series. For example, at the Stanford University computer center, IBM offered that a portion of rentals paid for lease of a 360/67 computer could be applied on a purchase of a 360/75 computer at such time as the customer should desire to upgrade to the more powerful machine. Records based on preliminary investigation list several other customers to whom such offers apparently have been made, including Boeing Company and Lawrence Radiation Laboratories at Livermore, California, a facility operated by the University of California for the Atomic Energy Commission. Subsequent to these offers, on October 1, 1965, IBM announced a new marketing plan which in substance appears to embody the transferable purchase credit program. A copy of the announcement is attached in Appendix 9. We understand that IBM's U.S. Government General Services Administration price list has for several years contained provisions also offering such a program.

Through this device, IBM initially is able to forestall sales by competitors who in fact have more powerful machines developed and ready for delivery, by pointing out that the customer would be receiving an interim 360 machine which could later be replaced by a more powerful IBM machine at, in effect, a substantially reduced price. Then, when the customer has signed such a contract, it is wedded to IBM, because the customer cannot afford to throw away the substantial price benefit of applying its rentals toward a purchase of an upgraded machine. Moreover, the longer IBM slips its deliveries and the greater IBM's delay in developing a more powerful 360, the tighter the knot is drawn, since the customer's credit rentals presumably are mounting. Thus IBM gains valuable development time, yet retains its monoply position at the expense of more advanced competitors. That the purpose of the device, as well as its effect, is to prevent sales by competitors is made clear by the fact that it is offered at a time when IBM is unable to deliver the more powerful types of computers at as early a date as can some other manufacturers and is unable to meet its announced delivery schedules.

2. *Price Cutting and Manipulation*

(a) Educational Discounts.

IBM has cut prices in the educational market with the purpose and effect of excluding and hindering competition. Recently IBM has intensified this price cutting by increasing the dollar amount of the price cuts. IBM's price cutting in the educational market constitutes singling out for special price concessions a particularly important category of customers for whom IBM is experiencing unusually severe competition and upon whom one of its major competitors, Control Data, is much more dependent than IBM or other manufacturers. IBM's price cutting in this market has extended so far as to involve outright gifts of computers and computer time to exclude competition.

The educational market is an extremely vital one to any computer manufacturer. It is at educational institutions that persons are being trained who will, in the future, be in the position of deciding for government and industry what manufacturer's computers to acquire. If these persons have been trained on IBM computers, they will have a natural inclination to later recommend them. Further, any individual sale to an educational institution is also likely to have greater importance in immediately stimulating sales to other customers than is true of sales to commercial or governmental users. Much of the most advanced work in application of computers is being carried on at educational institutions and selection by an institution of a computer of a particular manufacturer is likely to give that manufacturer considerable prestige which will be helpful in making other sales. Moreover, there is considerable national and international exchange of computer programs and computer processed data among educational institutions and such exchange is facilitated if the institutions engaging in it have computers which are compatible with each other.

Most important, the intellectual capabilities of the teaching and research staff people found at leading universities are unique. Over the years, these people have insisted on surrounding themselves with the most-advanced computers available to execute the complex arithmetic of their theoretical formulas, which are applied in almost every conceivable advanced field of research. The practical results of their unique work will profoundly influence computer usage in all of these fields in future years. The government has designated a few leading universities, including Carnegie Institute of Technology, Stanford University and Massachusetts Institute of Technology to receive special advanced projects and support to expand their research work to develop new technologies. The U.S. Government support includes heavy funding for the purchase of computers for these projects. IBM has made a particular effort to obtain orders at these few universities so that the services of their leading scientists, otherwise unobtainable, will be devoted to developing computer technology and programs for use on IBM computers. Thus, this technology becomes available to IBM instead of to its competitors.

IBM has through the years offered discounts from its standard or list prices for sale or lease of its computers and related equipment to educational institutions. Prior to about April 1, 1963, a twenty per cent discount was available to any accredited college or university for its business and administrative data processing and a sixty per cent discount was available to such institutions on equipment to be used for research or teaching. Effective about April 1, 1963, the sixty per cent discount was withdrawn. However, customers which, prior to April 1, 1963, had been offered sixty per cent discounts orally or in writing for IBM equipment to be delivered after that date were permitted to retain the discounts if firm orders were given within a stated time period.

Despite IBM's substantial discounts, in the mid-1960's Control Data began to experience some success in the educational market. While IBM was able to retain about the same percentage of that market as it had of the entire computer market, 70%–80%, Control Data offered stronger competition for that market than IBM experienced from any competitor for the market as a whole. Control Data became second to IBM in the educational market, capturing about 12% of it. In the market as a whole the nearest competitor to IBM had only 7% of the market. Concomitantly, Control Data became more dependent upon the educational market for business than was any other manufacturer, including IBM. 12% to 13% of Control Data's business came from the educational market, compared with 4% for IBM. IBM subsidized price cuts in this market by its sales in other markets, particularly injuring its primary competitor in the educational market, which, unlike IBM, was dependent on that market.

As Control Data continued to prosper in the educational market IBM became more concerned. In the Spring of 1964 a new man was put in charge of IBM's educational and scientific sales division with orders from above to "stop Control Data." Finally, Mr. Thomas J. Watson, Jr., in a speech delivered at a salesmen's convention in April, 1965, stated, in substance. "We have been living with the lawyers breathing down our necks trying to live the letter of the law of the Consent Decree. Gentlemen, we are not going to lose any more educational or scientific business." High executives, as well as salesmen, were quoted as saying that IBM intended to lose no more educational accounts, at any cost.

These words were soon borne out by actions. In May of 1965, IBM revised its educational grant policy in a manner which would greatly hinder further penetration of this crucial market by Control Data and other manufacturers. In light of the above described statements by IBM officers and employees it is clear that this was the intent of the revised educational discount policy, as well as of educational discounts or price cuts granted by IBM under earlier policies.

Under the new policy educational accounts are again being offered discounts substantially in excess of 20%. Moreover, such customers are offered increasingly larger percentage discounts as the power of the computer being considered by the customer increases. Thus, the highest educational discount is available on the most powerful computers, the 360/75 and 360/92, and this is precisely where IBM's product line is the weakest and where IBM receives the greatest competition from Control Data.

The following chart sets forth the discount scale.

IBM computer:	*Percent of discount*
360/20	20
360/30	20
360/40	30
360/44	30
360/50	35
360/65	40
360/67	40
360/75	45
360/92	45
2360, 2362 (core memory)	40
2361 (bulk core)	45
All other peripheral equipment	20

NOTE.—Attached as app. 10 is a schedule of educational discounts granted within the last several years by IBM. It is only a partial listing, based on information made available to Control Data from its salesmen's reports. It is submitted in response to a request of the Antitrust Division that we document such of these discounts as are within our knowledge or belief.

It is unlikely that the greater discounts are available on the larger machines because IBM has a greater profit margin on these machines. IBM reportedly follows a uniform ratio of cost to price throughout its product line.

In revising its discount policy, IBM not only increased the dollar amount of its price cutting in the educational market, it expanded the category of customers eligible for price cuts exceeding 20%, in an effort to further inhibit competition in that market.

Discount in excess of 20% are no longer available only to institutions using the computer for teaching or research. Apparently the present discount schedule is available to any accredited college or university for any computer usage. This interpretation is supported by recent indications that IBM will offer an educational discount to Stanford University for a computer to be immediately transferred by the University to the AEC for installation at the Stanford Linear Accelerator Center (SLAC), which will be operated by the University for the AEC. And at a recently established "research triangle computing center," jointly operated by three Southern universities, IBM has apparently offered discounts to the Triangle although substantial amounts of computer time will be sold by the Triangle to industrial firms in the area. Many other educational institutions to whom IBM sells computers sell their excess time to non-educational institutions.

In addition to its use of educational discounts to defeat competition in the educational market, IBM has on numerous occasions used outright gifts to achieve the same end and thereby retain or extend its monopoly. These giveaways frequently are in the form of buildings to house computer facilities or

money grants to sponsor research projects or endow professional chairs. Often the gift offered is free usage of computers. A gift by IBM of money or a computer or the right to use a computer not only forestalls competition between IBM and other manufacturers for an installation which might otherwise be purchased or leased, but it also frequently influences future computer installations by the customer. The customer may either feel indebted to IBM for the prior gift or may fear that if it later patronizes another manufacturer the gift will be withdrawn.

The University of California at Los Angeles exemplifies this situation. Sometime in the 1950's, IBM established the Western Data Processing Center on the U.C.L.A. campus. The IBM computers in this facility are available for use by the U.C.L.A. faculty and faculties of a number of other universities, free of charge. It is understood that the faculties use one daily shift of time at the center, and that IBM uses the other two shifts. The building in which the center is installed apparently is owned by the university and made available to IBM rent-free. Presently, the facility furnishes the universities free use of an IBM 7094 computer and other equipment, the total rental value of which is approximately $100,000 per month.

Presence of the Western Data Processing Center on the U.C.L.A. campus acts subtly to influence decisions of the university as to which manufacturer's computers will be acquired by the university. For example, in the spring of 1965, Control Data and IBM were in competition for sale or lease of a computer system for use on an ARPA (Department of Defense Advanced Research Projects Agency) funded project involving research into communications between computer systems. Control Data offered three 3200 computers and IBM offered three 360/40 computers. It became known unofficially that Control Data had been tentatively selected as the supplier. At this point, IBM announced that it had decided to install a 360/40 computer at the Western Data Processing Center, which would be available for this project. Thus, the customer needed to purchase or lease only two computers. The customer selected two IBM 360/40s. This same subtle influence applies throughout the University of California complex.

Preliminary investigation discloses a number of other offers of free computer usage by IBM to educational institutions. In March of 1964, IBM offered to the University of California at San Diego a free 7090 computer ordinarily priced at $3,048,000 (or a 7094–II at a price discounted from $3,420,000 to $800,000). In January of 1965, IBM offered a free STRETCH computer to Carnegie Institute of Technology. Sometime in 1965, IBM offered to give the University of Illinois a free 360 Series computer for an 18-month project. Such offers by IBM have not been limited to the United States. We have received reports of offers by IBM of free 7090 computers to at least eight foreign educational institution, most of whom have accepted and installed the computers.

IBM's practices in the educational market constitute a violation of the antitrust laws. Initially aware of the great importance of this market and particularly of certain key institutions wtihin the market and thereafter finding Control Data threatening its position in the market, IBM cut prices, subsidizing the price cuts by sales at list or standard prices to other categories of customers. The intent and effect of this price cutting was to prevent competition in the educational market. Since the market accounts for but a small percent of IBM's total computer sales, whereas it is a much more significant market for Control Data, it is an ideal battleground for IBM, which unlike Control Data, need not be concerned whether it realizes a profit on sales in that market.

(b) Buybacks; Extraordinary Programming and Maintenance

IBM has engaged in indirect price cutting and price manipulation to prevent competition by offering certain customers for whom competition is particularly serious, or who would be particularly prestigious customers, buybacks and programming or maintenance services not generally offered to other customers.

Buybacks may take several forms but, in general, constitute reduction of the purchase price or rental to be charged the customer on the understanding (i) that IBM can use a portion of time on the computer the customer will acquire or (ii) that the customer will perform certain work on the computer, such as programming, for the account of IBM. While the details of such arrangements usually are not available to Control Data, it is believed that in instances the price reduction is in excess of any value to IBM which could be attributed to the buyback.

We understand that buybacks recently have been offered by IBM in connection with computer procurements by Washington State University; the University

of California at San Diego; the Southern Research Triangle jointly operated by Duke University, the University of North Carolina and North Carolina State; Lawrence Radiation Laboratory at Livermore, California; and Knolls Atomic Power Laboratory operated by General Electric for the AEC. Within the last several years, IBM has combined buybacks with large educational discounts to provide computers practically free of charge to U.C.L.A. and Stanford University. Only a monopolist, with the tremendous resources and market advantage available to it, can afford to engage in such indirect price cutting.

In addition to price cutting to thwart competition by means of buybacks, IBM has abused its monopoly position by insidious price cutting in the form of extraordinary programming or maintenance services offered to particular customers for whom competition is especially serious. Such offers have been made to all types of customers—educational institutions, governmental agencies and commercial users. The price cutting takes the form both of increasing service to a customer when it appears the customer is considering replacing IBM equipment with competing equipment, and including extraordinary services in initial offers where the competitive situation so demands. The following are examples:

(1) In recent competition for a major computer system to be installed at NASA's Goddard Space Flight Center, IBM offered approximately 125 man years of free programming support compared to the 30 man years which Control Data was able to offer. At $20,000 per man year this is equal to a $2,500,000 discount on a system where the list price was allegedly but about $8,000,000 initially.

(2) At Washington State University, when it became known that consideration was being given to replacement of an IBM 709/1401, IBM brought into town two customer engineers and an analyst to replace the one customer tomer that had been there servicing IBM equipment. IBM told the customer that if it purchased a 360/67 these men would be assigned to the customer for the new equipment.

(3) In September, 1964, Sunsweet Growers contracted with IBM for a 360/30 system instead of a Control Data 3100 system, selecting IBM partly because it promised to make available four IBM employees to assist in conversion of the present equipment to the new system.

3. Market Exclusion

IBM's previously discussed practices of locking in customers and price cutting are employed with the intent and effect of excluding and hindering competition in the computer market and various segments of it. In recent competition against IBM for certain key computer customers Control Data has encountered particularly determined use of these practices by IBM to prevent Control Data from making a sale. Examples of such instances are discussed separately below because they illustrate combined use of some or all of the practices previously described and, in addition, involved customers to whom a sale would have particularly great positive influence upon subsequent sales to that and other customers.

(a) During the fall of 1965, negotiations for lease of a CONTROL DATA 6400 computer system to the Missiles Division of Raytheon were in progress. IBM was aware that a sale to Raytheon would open a door in New England to Control Data, being the first installation in that area of a CONTROL DATA 6000 series computer. Such a sale would greatly assist Control Data in competition for future sales to such customers as Harvard University, MIT, Sylvania, General Dynamics and United Aircraft. IBM, therefore, asked the customer what the price difference was between the IBM proposal and Control Data's lower quotation ,and, after being given the figure, stated that they would provide enough free rental to equate the price of the two proposals. IBM assured Raytheon that it could assume that the cost of IBM equipment would be as low as the cost of Control Data equipment.

(b) Similarly, in recent competition at Washington State University between an IBM 360/67 system and a CONTROL DATA 6400 system, a receipt of the order by Control Data would have resulted in installation of the first 6000 series equipment in the Pacific Northwest. Aware of this, as well as of the considerable prestige of Washington State computer personnel, IBM offered an educational discount, gift or consignment of certain peripheral equipment, reduction of rental on presently leased IBM equipment to 10% of normal rental for at least a four-month period during conversion to the new equipment, furnishing of ex-

traordinary service personnel to influence the sale, and, probably, a buyback in the form of a joint software research program. Washington State decided to acquire the IBM 360/67.

(c) Lawrence Radiation Laboratory, operated by the University of California for the Atomic Energy Commission at Livermore, California is one of Control Data's major customers. Livermore is also one of the most prestigious computer users in the world and has for years operated the world's largest known aggregation of computers. In recent competition for sale or lease of a computer system having the power of the CONTROL DATA 6800 system, IBM offered a combination of inducements having the practical effect of reducing the cost to the customer of a $4,000,000 to $6,000,000 system to approximately $1,000,000. The inducements included a buy-back by IBM of time on the system and of programming services to be performed by the customer; interim installation of a 360/75 system, the rentals for which would be in part applicable against the purchase price for the 360/95 system ultimately to be installed; and some type of arrangement whereby peripheral equipment would be provided free of charge for a year. During negotiations IBM also indicated to the customer that it was considering setting up an IBM research laboratory in or near Livermore, California.

4. "Fighting" Machines

Preliminary investigation suggests that IBM has made use of "fighting" machines on various occasions. Where IBM has found gaps or weaknesses in particular segments of its product line resulting in competitors realizing significant sales IBM has responded by introducing equipment specifically designed to fill the gaps and eliminate the competition, which equipment apparently has been priced below IBM's usual margin of profit.

Data on IBM's profits on specific pieces of equipment is not available to Control Data. However, Control Data can infer on the basis of price/performance information that the IBM equipment referred to below was "fighting" equipment priced below usual profit margins. It is suggested that this area would be a fruitful one for further investigation.

Information now available indicates at least two IBM computers which are "fighting" machines, the 7044 and the 360/44.

(a) *7044*. IBM's first large-scale, solid-state scientific computer was the 7090, first installed in November, 1959. An average 7090 system sold for $3,048,000 and leased for $67,400 per month. Suitable only for scientific applications, it had a Gibson Scientific Mix value of 5.82 microseconds per average instruction, the mix value being a measure of power of a computer for scientific applications, a lower value indicating a more powerful computer.

In January 1960, Control Data installed its first 1604 computer. The 1604 was about two-thirds the IBM 7090 in performance, having a Gibson Scientific Mix value of 8.22, and one-half of the 7090 in price, selling for $1,410,000 and leasing for $42,000 per month. The 1604 achieved significant success, for IBM had no equipment in this price and performance category.

IBM, therefore, introduced the 7044, the first such computer being installed in June 1963. The introduction of the 7044 delivered a staggering blow to Control Data and for all practical purposes ended marketing of the CONTROL DATA 1604, being equivalent or superior to the 1604 in performance with a Gibson Scientific Mix value of 5.36 and renting for 25% less than the 1604 or $31,500 per month. The 7044 sold for $1,957,000. Note that while the mix value of the 7044 and 7090 were essentially equivalent, IBM offered the 7044 at one-half the lease price of the 7090 and two-thirds the sale price of the 7090.

(b) *360/44*. The IBM 360/44 was not a part of IBM's original April 1964 announcement of the 360 Series. It was not announced until August 1965. There is reason to believe that it was introduced specifically to eliminate the competition of the CONTROL DATA 3200, a machine which was effectively taking advantage of a gap in the IBM product line. There is also reason to believe that IBM is realizing a much lower rate of profit on the 360/44 than on most other equipment. This is suggested by the following data on prices and performance of the CONTROL DATA 3200, the IBM 360/44, and the IBM 360/40 and 360/50 which were a part of the original 360 Series announcement and were IBM's primary offerings to compete with the CONTROL DATA 3200 before the 360/44 was announced. Gibson mix values are in microseconds per average instruction and a lower value indicates a more powerful computer.

Model	Installation date	Average system: Lease (per month)	Average system: Purchase	Mix value: Scientific	Mix value: Business
IBM:					
360/40	April 1965	$12,500	$611,000	22.46	66.23
360/44	June 1966	9,800	422,000	4.64	
360/50	August 1965	18,000	883,000	5.71	27.14
Control Data: 3200	June 1964	11,500	541,000	3.70	22.15

It will be noted that the IBM 360/44 while having a scientific mix value essentially equivalent to the 360/50 sells and leases for one-half its price. Further, the CONTROL DATA 3200, priced at somewhat less than the 360/40 and substantially less than the 360/50 although outperforming both is now faced with a machine, the 360/44, having substantially the same scientific mix value and leasing and selling for significantly less.

5. Refusal to Lease to Competitors.

In addition to IBM's predatory pricing policies, IBM has recently launched a direct attack against its competitors in their capacity as IBM customers. On December 11, 1964, in a letter from McWhirtle, the president of IBM's industrial products division, to Norris, Control Data's president, IBM announced that effective that day "IBM equipment which is to be remarketed by other equipment manufacturers (would) be available on purchase terms only." Previously, equipment manufacturers requiring certain IBM equipment to complete systems to be leased to their customers could lease the equipment from IBM for sublease to customers.

For competing computer manufacturers, the IBM equipment that was the subject of this announcement is of immense importance in assembling and in selling their own computer systems. The CONTROL DATA 3000 and 6000 Series computer systems, for example, utilize IBM-manufactured chain printers and data cells. In terms of percentage of system cost, the IBM equipment when used comprises ten to fifty percent of the cost of these systems.

The economic effect of the new policy on IBM's competitors is enormously destructive. By forcing its less-financially advantaged competitors to purchase such equipment at retail prices, IBM has placed them in an untenable position. If Control Data makes a heavy capital investment by purchasing such equipment outright and then attempts to achieve some return on that investment, it is not competitive wih IBM. If, on the other hand, Control Data passes the equipment on at cost to its customers, thus remaining competitive, it is still crippled in its competitive battles with IBM by having much of its capital tied up in an unprofitable venture. Finally, if in order to free its capital, Control Data purchases on a time-payment plan from IBM, it must lease the equipment at a loss to remain competitive. Control Data is economically unable to compete whichever course it takes in response to the new IBM policy.

The effect of the new policy can be highlighted arithmetically. Assume Control Data has $5,000,000 to utilize in building computer systems. Assume, additionally, that 20% of each system is IBM equipment, and that each system costs $100,000. If Control Data had to invest $80,000 in each system, the $20,000 of IBM equipment being leased from IBM, Control Data could produce 62.5 computers. Because the new IBM policy forces Control Data to invest $100,000 in each system, Control Data is only able to produce 50 systems. The deleterious effect of the policy on Control Data's ability to compete with IBM is obvious.

The economic effect cannot be avoided. There are presently no alternative sources of supply for comparable equipment. Further, most customers are unwilling to lease such equipment directly from IBM for use with a Control Data system, since that course of action would divide responsibility for system maintenance and would create problems of on-site integration of the system.

IBM, in its letter of December 11, 1964, claimed that the new policy was necessary to protect it "from the risk of large-scale rental discontinuances." This is simply not the case and, in fact, is only a gloss designed to obscure IBM's predatory purposes. First, that same risk is run with every rental customer—only those customers who are also competitors are singled out for disadvantageous treatment. Second, since IBM's competitor-customers do not manufacture

the equipment they lease from IBM, they will not in fact discontinue the leases. The only reason that exists for the new policy is to make it materially more difficult for IBM's competitors to effectively compete with it.

It has been suggested that the new IBM policy is necessary because competitors leasing from it have often entered orders for quantities of equipment in excess of their needs with the intent of cancelling these excess orders before delivery. If IBM is unable to protect itself from such conduct, it is argued, IBM will find itself vastly overstocked in certain equipment. Of course, if such excess ordering does exist, IBM ought to be able to protect itself. But such protection does not require and cannot take the form of an exclusionary device. IBM's interests could be equally well secured by a penalty clause for cancellation before delivery or by a mandatory one-year lease or by some other contractural provision. It is unnecessary for this purpose that IBM's competitors be required to make a large capital investment in IBM equipment. IBM's monopolistic practice does not become any less violative because a business reason can be advanced to support it when that business reason can be satisfied in other non-monopolistic ways.

C. Miscellaneous unfair trade practices

This section of the Report deals with miscellaneous unlawful practices engaged in by IBM having the effect and intent of preserving its monopoly position and preventing competition in the computer market by Control Data and other manufacturers. Some of the practices such as disparagement of Control Data and coercion of customers are believed to result from IBM salesmen's desperate fear of losing any business. IBM has created an atmosphere which encourages its salesmen to go to any length to obtain or retain computer customers. The pressure from above stems partly from IBM's sales commission policy which reportedly penalizes a salesman for losing an existing customer by requiring that he repay the original commission on the applicable machine, whether or not he was responsible for the original sale or lease. IBM salesmen are further subjected to strict accountability and, at times, punitive action by their superiors in any case of a lost account or lost order. In several instances, it has been noted that an IBM salesman has been taken off an account or reassigned to other territory following loss of an account. The actions of IBM salesmen in the market place constitute policy in action and these, rather than any carefully drawn written policy, are the measure of legality of IBM's conduct.

The trade practices described below are submitted in response to requests from the Antitrust Division that Control Data report conditions encountered in the market place. In many instances they also serve to characterize and confirm the anticompetitive activity and predatory intent described previously. Viewed collectively, all of the activities complete, we submit, a pattern of attempt to monopolize and abuse of monopoly power by IBM. The practices took place primarily in 1964 and 1965, after the July 1963 announcement by Control Data of its 6000 Series of computers and coincidental with various "Stop Control Data" statements by IBM management.

1. Disparagement of Control Data

At several accounts during 1965 competition with IBM, Control Data has learned that IBM sales personnel have made false representations to prospective customers, including the following:

(a) Repeatedly advising a certain midwest industrial prospect that it would be risky to deal with Control Data because the company was on "shaky financial grounds." Representations of similar tenor were also reportedly made to another midwestern customer.

(b) Representing to a large west coast industrial prospect following completion of performance tests by Control Data, that the software proposed by Control Data would not perform as proposed, either stating directly or by implementation that Control Data had cheated on the tests or lied to the customer. IBM representatives persuaded the customer to require a re-testing in the presence of witnesses. Re-testing was in fact concluded satisfactorily and in the presence of witnesses.

(c) Representing to a southern university and to a midwest chemical company to the effect that Control Data's computers required excessive maintenance, with the obvious implication that Control Data's hardware was inferior.

(d) Representing to an investor through a top level IBM executive that IBM would force Control Data into a weak position in the computer market, the investor, being exhorted to sell any Control Data stock he might own: further, representing to the investor that major proposals including the University of Texas, which involved competition with Control Data, would be personally reviewed by IBM's top management and that IBM did not intend to lose any more of the university market and was, accordingly, returning to a 60% discount to educational institutions. The obvious effect of these representations to a single investor was to open the door to widespread repetition through investment grapevines.

2. Intimidation and Coercion of Customers

(a) *Customer Procurement Personnel.* IBM's practices in this area must be considered against the following background. IBM's monopoly has created customer resistance to changing brands of computers. Nearly all prospects for Control Data computers are existing IBM customers and "status quo inertia" is very widespread. Only the very highly technically qualified user personnel and purchasing agents are able to make comparative evaluations between IBM computers and other computers. These people are scarce and are found primarily at such agencies as the Atomic Energy Commission, the Department of Defense and large universities. Absent qualifications to critically compare competing equipment, the tendancy is to purchase IBM because that is the best known brand. Such a decision need not be justified to superiors, whereas purchase of a non IBM computer may require extensive justification. Because of this predisposition to question any decision against IBM, customer personnel responsible for deciding upon computer acquistiions are peculiarly vulnerable to intimidiation by over-aggressive salesmen.

This vulnerability may be intensified in the case of lower echelon customer procurement personnel because their superiors may well be former IBM employees. A substantial portion of computer customers rely upon employees or independent consultants who are IBM alumni for advice and decisions on computer acquisitions.

One of the most flagrant examples of intimidation by an IBM salesman occurred in recent competition between an IBM 360/30 and a CONTROL DATA 3100 at a west coast local government agency. The customer's computer manager advised the Control Data salesman that he was fearful of losing his job. He had recommended the Control Data machine and believes that the IBM representative then went to his superior and stated that he was incompetent and should be replaced. According to the computer manager, his predecessor had recommended acquisition of a computer other than IBM and had forthwith been fired.

(b) *Other Coercion.* Another IBM practice has been described as a "burning the match offer". It is exemplified by competition last September between IBM and Control Data at a California industrial prospect. The customer notified IBM that it was going to replace its IBM Model 7044 computer with a Control Data computer as of a date certain. Due to problems in negotiating all of the contract details with Control Data, the customer later advised IBM that it would like to continue renting the 7044 several months past the specified change-over date. IBM's response was that unless the customer contracted for an IBM 360 Series computer within 48 hours, no extension could be granted as the Model 7044 had been sold to a third party. A contract for a 360 computer would resolve the problem, however, and a Model 7044 would be made available to the customer on an interim basis.

Similar coercion was exerted upon a major midwestern medical account by an IBM vice president. When the customer considered procuring a Control Data computer to supplement or replace existing IBM machines, the vice president advised the customer that unless IBM equipment were ordered a team of some 27 IBM engineers would be withdrawn. This team had been working with the customer, free of charge, conducting advanced systems development research for the mutual advantage of IBM and the customer.

3. Reciprocity

IBM has engaged in various forms of reciprocity with its customers and suppliers.

One such tactic involves the investment of large sums of money for new factories or assembly plants at or near the customer's place of business. Several such

announcements have been timed to coincide with fierce competitive efforts between IBM and Control Data. The obvious economic advantage to the customer and the entire surrounding area is a persuasive sales implement in this situation.

An example of this occurred recently in the southern part of the United States, where IBM reportedly has leased land for its new plant from its customer and will buy back time from the customer on a yet-to-be-installed 360/67 time sharing computer system. One of the architects of the overall marketing arrangement is a former employee of IBM often referred to as the "father of the 360 Series." This IBM alumnus is presently an employee of the customer but reportedly is still receiving retainer compensation from IBM.

Another example occurred during a competitive situation in a section of the western United States. IBM announced plans to build a large manufacturing plan there within days after announcement of a single sale by Control Data in this geographical area, which has large potential for additional computer sales. This announcement was made by Mr. Thomas J. Watson, Jr., coincidentally with a dinner meeting attended by the area's most influential computer prospects.

A number of IBM gifts of buildings to accommodate university computer centers offer additional inferences of the type of reciprocity.

Incomplete investigation also has revealed a number of instances where deposits of funds in the million dollar range have been made by IBM in certain banks with no legitimate business reason. Control Data does not have the facts as to the coincidence of these deposits and competition for computer procurement at these banks. We believe, however, that a Civil Investigative Demand would disclose a number of instances of implied, if not contractual, reciprocity between these banks and IBM.

Supplier reciprocity is suggested in the relationship between Fairchild Camera and Instrument Corporation and IBM. The chairman of Fairchild's executive committee is a director of IBM. IBM purchases several items from Fairchild and Fairchild, in return, uses IBM and its subsidiary, Service Bureau Corporation, for its data processing needs. Further, a design and patent cross-licensing agreement between the two companies recently was announced. The question arising from these facts is, "Would an illegal reciprocity pattern unfold in response to a Civil Investigative Demand requesting details of these various company interchanges?"

4. Undue Influence of Customers' Specifications and Tests

A substantial portion of requests for computer proposals published by prospective purchasers contain specifications which are oriented toward or actually copied from IBM literature—sometimes with the assistance of IBM employees handling these customer accounts. Many are biased in favor of IBM because customers naturally use the monopolist in the field as a standard and because many procurement committees are composed of one or more IBM "alumni". Competition at NASA, for instance, has been reduced to almost a minimum because IBM has gratuitously acted as NASA's computer evaluator and has recommended that IBM be selected as sole source supplier, at least as to certain of the NASA systems. NASA's recent recognition of the need for additional competition is reflected in the letter of Mr. James Webb, dated December 7, 1965, a copy of which is attached as Appendix 11, referring to NASA's "future plans to increase competition."

Not all biased specifications and tests are the normal or inevitable result of monopoly conditions. At one government computer procurement in 1965, a group of four customer employees were, in varying degrees, instrumental in evaluating the customer's needs. Competitive tests were set up to be run on a Control Data computer as against an IBM computer to assist the customer in choosing between the two competitors. Of twenty separate tests proposed, one of the four employees selected thirteen to be run in the competition. All thirteen of these tests had formerly been operated successfully on the IBM computer and none of the remaining seven tests had been so run. When the contract was nonetheless awarded to Control Data, all four of the employees left the customer to take employment with IBM.

In addition to being instrumental at many customer sites in drafting specifications and influencing tests, IBM reportedly has in at least one instance prepared and submitted to a customer, a government agency, false results in response to the customer's request that competing suppliers perform "benchmark" tests of their respective machines.

These situations lead us to suggest that an investigation of IBM's activities would disclose other improprieties in this area of trade practices.

5. Patent Practices

IBM has taken advantage of its ownership of thousands of patents relating to electronic data processing, the development of which in a significant sense was substantially financed by the U.S. Government, to prevent and hinder competition from Control Data in the computer market. While repeatedly threatening Control Data with serious patent infringement litigation, IBM has refused to license Control Data under its patents on reasonable terms or on terms as favorable as it has offered to most other computer manufacturers, with whom IBM has entered into a patent pool from which Control Data is excluded.

The U.S. Government, particularly the Department of Defense, has been the principal financier and stimulus behind electronic digital computer development in the U.S. Defense Department computer experts have stated that DOD has spent on an average of $150 million per year directly supporting computer research and development over the past ten to fifteen years, plus considerable indirect support by way of research and development monies made available out of profits on standard computer products purchased by DOD. These experts state that the U.S. computer art has been largely supported and moved ahead by DOD monies. IBM has been the primary beneficiary of this direct DOD research and development support. IBM has probably received upwards of a billion dollars of research and development funds from the U.S. government directly and it is largely on this base that IBM's technology is built. In addition, IBM receives 70–80 per cent of revenues paid by the U.S. government for standard computing systems, said revenues indirectly supporting additional large amounts of IBM's research and development program. Under these circumstances IBM has built a patent portfolio of approximately 3,000 U.S. patents and 8,000 foreign patents.

IBM has royalty-free cross-licenses with most of the large companies who are its competitors in the computer field, including Sperry Rand, RCA, Honeywell, International Computers & Tabulators, Ltd. (England), Burroughs, Philips (Holland), Teleregister, Siemens (Germany) and others. By these royalty-free cross-license agreements, IBM and its major competitors other than Control Data have insulated themselves from patent infringement attacks, creating what is probably one of the largest single patent pools in the world. Having created these cross-licensing arrangements, several of the participants, including Sperry Rand and Honeywell, have filed patent suits against Control Data, and IBM has threatened to do so.

Patent licensing discussions between Control Data and IBM, instituted at the initiative of IBM, have continued for several years. However, unlike its treatment of other manufacturers, IBM proposes that Control Data pay IBM royalties, claiming that it has no need for any Control Data patents. In fact, the measure which IBM uses to establish the amount Control Data should pay for such a license has been equated by an IBM executive to the alternate cost to Control Data to defend itself against a lawsuit by IBM.

IBM has also demanded other provisions in any patent license to be granted to Control Data which belie any intent to enter into a fair agreement and suggest that IBM's primary purpose is to coerce and intimated Control Data. IBM thus far has made no serious offers to grant a license under a single patent for any appreciable amount less than the rate for two or more or all of its patents, thereby coercing Control Data to make an umbrella license for a package comprising all or most of IBM's foreign and domestic electronic data processing patents. To take such a license is to admit validity of all patents in the package. IBM has also insisted on other unreasonable provisions, including a grant-back by Control Data of licenses of its patents to IBM notwithstanding IBM's statements that it feels no need for such Control Data patents.

IBM's discriminatory, unreasonable and coercive treatment of Control Data in the area of patents—particularly its demand that Control Data suffer the competitive disadvantage of paying royalties not exacted from others—constitutes unlawful monopolization and attempt to monopolize.

6. Other Practices

Control Data believes that IBM has attempted to monopolize and abused its monopoly power in the following additional areas, but as yet has insufficient documentation to warrant a more detailed statement.

(a) IBM has established an exclusive organization comprising certain of its customers, known as SHARE. Only customers using IBM's larger systems are qualified members. Developmental work on computer programs by IBM and by members of SHARE is made available to all members with IBM acting as dis-

tributor, free of charge. IBM maintains SHARE's program library and distributes its programs to members upon their request. The programs are normally made available exclusively to SHARE members.

IBM and SHARE have recently jointly developed a new program language ("NPL"), later changed to "PL–1". Control Data requested an opportunity to participate in the development of this language, but IBM refused. IBM, with its large percentage of the market, sets de facto standards in programming languages as well as in hardware. Control Data must insure that this new language can be utilized on its equipment. Although the language specifications eventually are being made available publicly, the lead time IBM gains in refusing others access to the development of new languages tends to further entrench and extend IBM's monopoly.

As an adjunct of the IBM 360 Series, IBM announced in 1964 that it would change the codes, recording densities, signal intensities and other characteristics of its magnetic tape. Having made this announcement, it was many months before IBM disclosed any information on what these new standards would be. Recently, however, IBM has disclosed these new standards and once again its competitors, including the independent suppliers of peripheral equipment, must adapt to them. Only after all the details of the new IBM standards are made known will competitors be able to modify their products to achieve compatibility. Such modification will thereafter take at least two years and cost millions of dollars; in the interim IBM will have a tremendous competitive advantage.

(b) IBM's written corporate policy precludes further sales efforts by its salesmen after a customer is committed to a competitor's machine. Any such activities by IBM salesmen, contrary to this policy, might also constitute monopolizing under the antitrust laws or the independent tort of "interference with contractual relations." It is believed that IBM, in violation of this policy, has continued and intensified its sales efforts with respect to certain customers after the award of a contract to Control Data. If further investigation confirms this belief, the details will be made available to the Antitrust Division, if requested.

(c) Paragraph VIII of the 1956 Consent Decree proscribes IBM's activities with respect to its service bureau. Shortly after entry of the decree, IBM established its data centers division and, more recently, its test centers. Through manipulation of these two centers, which IBM currently operates in a number of cities, and by controlling the activities of Service Bureau Corporation, its wholly-owned subsidiary, it is believed that IBM is using its position in the data processing industry to monopolize the computer industry.

III. SUGGESTED RELIEF

(A) The major underpinnings of IBM's monopoly power have been its tremendous assets and its ability to spread its development costs over the many units of equipment sold. The most effective means of neutralizing this monopoly power would be to divest IBM of those assets which have given it much of its financial strength, but the absence of which will not impair its ability to compete as a computer manufacturer. Divestitute of IBM's typewriters, dictating equipment, tabulating equipment, data processing, and computer peripheral equipment (printers, memory units, and tapes, discs, and drums) division would reduce IBM's financial muscle and impair its ability to engage in those predatory activities in the computer market which we have described. The deletion of the peripheral equipment division would also deprive IBM of the sales tool of offering a full line of computer equipment and would place it in the same posture in the market place as its competitors. The availability of said peripheral equipment to IBM's competitors and to IBM at uniform specifications, terms and prices would assure competitive compatibility in the industry. Finally, such divestiture would have the additional collateral advantage of restoring competition to the peripheral equipment market, which at the present time is strangling under IBM's monopoly hold.

(B) An alternative to divestiture, designed to achieve the same result, would be a provision, similar to that found in the 1956 Consent Decree, requiring IBM over a period of time to reduce its market share with respect to all markets and all relevant products in the electronic data processing field to no more than 50%.

(C) To avoid in the future IBM's use of "paper machines" as a means of forestalling sales by its competitors, IBM should be prohibited from selling, advertising or taking orders for computer systems not yet operational in its laboratories and from specifying delivery dates which it cannot reasonably meet. Special computers specified by customers would be excepted from this prohibition.

(D) Because IBM has installed over 70% of the computers now in operation, and because computer customers require that machines be compatible, IBM constructively sets the hardware and software standards for the industry. Any changes in such standards by IBM requires immediate copying by its competitors if they are to survive. In the past, IBM has kept these technical changes secret until they are to be marketed, thus gaining valuable lead time over its competitors. So long as IBM retains its monopoly position, it must be required to reveal these hardware and software changes far enough in advance of its marketing so that its competitors can adapt and continue to compete in equal time. IBM must not be able to drive its competitors from the market place for a period of time simply by making technical changes in its equipment. Also, IBM must be required to separate itself from its customer software group, SHARE, or to open membership in that group to all its competitors so long as that organization is used as a means of making technical changes, such as the development of a new programming language, which will retard IBM's competitors.

(E) With respect to pricing, IBM should be

1. Prohibited from selling or leasing below cost.

2. Prohibited from discriminatorily pricing in any market so as to preclude the special discounts IBM has given in the past to those customers to whom sales would be the most promotive of further sales to others.

3. Required, in order to prevent avoidance of the provisions of any decree, to make all offers to sell in writing and to price separately, and nondiscriminatorily;

(a) All hardware, including systems and units;

(b) All programs and programming;

(c) All customer services, including maintenance;

(d) All other goods and services, including services of Service Bureau Corporation, data centers and test centers.

4. Required, in order to prevent avoidance of the provisions of any decree, to contract separately and in writing for the purchase from any customer or employee of any customer of:

(a) Computers;

(b) Computer time;

(c) Programming services; or

(d) Other property or services.

5. Prohibited from offering discriminatory discounts based on computer size.

6. Prohibited from reducing its rental prices on installed IBM equipment in order to induce any customer to purchase or lease new equipment from IBM for future delivery.

7. Prohibited from allowing rental payments on an installed IBM computer to be applied against the purchase price of an IBM computer ordered for future delivery.

(F) Because of its established tendency to utilize reciprocal buying power as a sales inducement, IBM should be prohibited from procuring goods or services from customers or potential customers with the intent to affect their buying practices.

(G) IBM should be required to sell and lease its products to its competitors on as favorable terms and conditions as it sells and leases such equipment to its other customers.

(H) IBM should be required to license all of its patents to Control Data on as favorable terms and conditions as it licenses those patents to other major computer manufacturers.

(I) IBM should be prohibited from making any disparaging statements about its competitors or their products and services.

(J) IBM should be prohibited from directly or indirectly drafting or assisting in the drafting of computer specifications published by potential customers. IBM should also be prohibited from directly or indirectly designating the tests required of potential sellers' computers by any potential purchaser.

(K) All the requirements and prohibitions cited above should be equally applied with respect to IBM World Trade Corporation and all other subsidiaries of IBM.

IV. CONCLUSION

This Report describes International Business Machines Corporation's monopolization of and attempt to monopolize the automatic data processing industry.

It requests that the Antitrust Division investigate and take action against these antitrust violations which, if not eliminated, will result in substantial permanent impairment of competition in one of the nation's most vital industries, an industry which is certain to assume even greater importance in succeeding years. The sales reports and other documents upon which the above charges are based are in the possession of the undersigned. They are available for inspection at the request of the Division. Control Data officers and employees with more detailed knowledge of the facts also stand ready to meet with Division representatives upon request to expand or explain the contents of the Report.

Respectfully submitted,

OPPENHEIMER, HODGSON, BROWN, WOLFF & LEACH,
Attorneys for Control Data Corporation.

Appendixes: (11).

Appendix 1

Washington Post—July 8, 1965

TWO MORE COMPANIES LEAVE THORNY COMPUTER MARKET

(By Dennis Duggan)

In the past few weeks, the departure of two companies from the fiercely competitive computer market has underscored a point: The gate to the computer business is clearly double-hinged.

Companies come and companies go. In recent months, General Precision Equipment Corp. and Union Carbide Corp. decided they were not meant for the computer industry.

Carbide's quick exit from an industry in which it spent only 13 months recalls some other outstanding industry shipwrecks on the shoals of this big but tough-to-conquer industry.

Bendix Corp. played a waiting game between 1955 and 1963 which industry experts say cost the company something like $30 million. Bendix called it quits in March, 1963, when it sold out to Control Data Corp.

Royal McBee also sat in on the game. Royal threw in its cards early in 1963 after suffering losses of $1.7 million in 1962 and $1.1 million the year before.

It sold its half interest to General Precision for $5 million that wheel came full (circle) early this year when General decided it had suffered enough.

A SURPRISE EXIT

Control Data Corp., of Minneapolis, a specialist in big, scientific computers, is acquiring General Precision's commercial computer assets in a transaction expected to be completed soon.

Carbide's decision to quit the computer market comes as something of a surprise. It has both the money, (sales last year ran to $1.87 billion) and the marketing muscle to make a serious run at the market.

But on June 30, it joined the long list of computer has-beens. The company's official explanation for quitting is that "the projected rate of growth in digital computer equipment has not been realized."

Homer Morrison, sales promotion manager of Carbide's Linde division, to which Data Systems reported, explains that the parent bought Data in 1964 to tie in with their acquisitions in the electronic field.

"We also thought the company would give us a corner in the basic digital computer market." He adds: "We discovered plenty of competition."

"JUST LOST INTEREST"

According to industry estimates, Union blew slightly more than $1 million in an attempt to expand the marketing of Data Systems' computers—a small systems unit selling for about $12,000.

Data Systems unveiled a new $20,000 computer at a recent computer show in New York. Morrison says of the new machine—the DSI 2000—"We just lost interest in it."

But while Union Carbide lost interest in Data Systems, that firm's president and co-founder, Samuel Erwin, disagrees with Carbide's contention that the company wasn't growing fast enough.

Appendix 2

Shaping new links in man/computer communications . . .

ONLY THE POWER OF A CONTROL DATA ® 6600 COMPUTER SYSTEM COULD SATISFY THE NEEDS OF CERN, THE 13-NATION NUCLEAR RESEARCH CENTER

6600 POWER

132,072 words of one microsecond core memory with a 32-way interlace permitting successive accesses at 100-billionths of a second.

Capable of processing more than three million instructions per second. Handles up to 11 programs simultaneously through central processor and 10 peripheral processors.

Multi-processing capability ideal for time-sharing requirements of large scientific computing organizations.

Provides memory protection and dynamic relocation of partly executed programs essential to operating without restriction in multi-programming mode.

The European Organization for Nuclear Research (CERN) on the French-Swish border required a new and unique computer system—the CONTROL DATA 6600. Only this computer could provide the power and accessibility necessary to make it an integral part of CERN. The 6600's unique organization allows the hundreds of theoretical and experimental physicists, engineers and technicians at CERN to share in its operation simultaneously. On-line experiments, on-line film measuring devices and many remote consoles, typewriters and plotters—in addition to 400 FORTRAN programs daily—will tap the 6600 on a time-sharing basis.

Concurrent parallel operations on the 6600 are achieved through the simultaneous processing of input and output information by the 12 data channels and the 10 peripheral processors on one hand and the central arithmetic processor on the other. The speed and efficiency of processing data is further enhanced by putting the entire 6600 system under the control of a single overall monitor known as SIPROS—the CONTROL DATA Simultaneous Process System. For more information on this and other Control Data computer systems, contact your nearest representative or write direct to our Minneapolis address, Dept. G–95.

Appendix 3

The Wall Street Journal, Friday, January 21, 1966

IBM PLANS TO DELIVER SIX "SUPER COMPUTERS" NEXT YEAR AND 12 IN '68

TWO MODEL 90 MACHINES WILL GO TO NASA UNITS, ONE TO PRINCETON, ONE TO LOCKHEED DIVISION IN '67

(By a Wall Street Journal Staff Reporter)

NEW YORK.—International Business Machines Corp. announced plans to deliver six "super computers" to customers in 1967 and to increase the pace of deliveries to one a month beginning in January 1968.

The installations next year will be the first of IBM's Model 90 series, the upper end of the System 360 family of computers. The first delivery of one of the big machines will be made in the first half of 1967, the company said.

Each of the model 90 series is valued at $6 million, including peripheral equipment. Thus, the combined value of the six machines to be delivered next year is about $36 million and the combined value of the 12 slated for delivery in 1968 is $72 million.

There have been published rumors in the trade that IBM would drop out of the super-computer market, but the company's announcement of delivery schedules for Model 90 machines has the effect of scotching this talk.

One each of the giant computers will be installed next year at the National Aeronautics & Space Administration's Goddard Space Flight Center in Greenbelt, Md., and its Goddard Institute for Space Studies in New York City. Both machines have been purchased outright.

Deliveries next year of one machine each will also be made to Princeton University and Lockheed-California Co., Burbank, Calif., a division of Lockheed Aircraft Corp.

IBM said Princeton and Lockheed have an option to buy the machines outright or rent them. The other two customers slated to get machines in 1967 weren't identified.

IBM said all future orders for Model 90 series machines will be for outright purchase only, not rental.

The computers are designed for solving problems in such highly sophisticated areas as space exploration, subatomic physics, theoretical astronomy and global weather forecasting.

The machines have internal processing speeds up to 12 times faster than the next most powerful System 360 computer, the model 75, which sells for about $3 million. The Model 90 series processes data up to 100 times faster than the older IBM 7090, one of the most widely used of the large-scale computers.

Appendix 4

Datamation December 1964

Washington Report

PRICE-CUTTING STIRS MARKET

Of immediate concern to most Washington area computer sales reps is recurrent talk of price cutting, and possibly a partial withdrawal of the so-called IBM "price umbrella." IBM chairman Thomas J. Watson, Jr., stated in a recent interview that his company "is going to compete at whatever price level is necessary to maintain our position in the industry," words which were well-noted in Washington where IBM has lately finished out of the running on several larger procurements, largely on the basis of price.

Some claim price cutting has already put in an appearance. "It hasn't been too obvious," said one government marketeer, "but you take a machine, change its numerical designation and mark it down by 25%, and the effect is the same." The offering of substantial discounts by manufacturers for volume purchases, a boon to the government long sought by the General Accounting Office, is also becoming more common.

Appendix 5

EDP Industry and Market Report

IBM ADJUSTS MAINTENANCE RATES, ELIMINATES PRICE REDUCTION ON BASIS OF EQUIPMENT AGE, IN MOVE TO CONTROL PERCENTAGE OF ITS RENTED DP EQUIPMENT BEING PURCHASED

"The greatest difficulty in achieving forecasted goals of profitability in the computer industry is controlling the mix of sales vs. rentals of equipment", Control Delta's President William Norris was quoted as saying at CDC's Annual Meeting last month. No firm in the computer field is more conscious of this problem, nor more able to pioneer pricing policies to astutely control it, than IBM.

An example of IBM's exercise of this control is its announcement to its customers on October 1, 1965, outlining new arrangements under which a customer can purchase rented IBM equipment, and also adjustments on the maintenance charges that customers with purchased IBM computers or punched card equipment are required to pay for IBM service on their equipment. To explain these changes, let's contrast them with policies previously in effect.

"PURCHASE-OF-RENTED" PLAN

Prior to October 1st, the purchase price of rented IBM computers and punched card equipment to a customer with the equipment installed was based on the length of time the equipment was installed. For computers, the purchase price declined 5% a year for the first four years of use, and 10% thereafter until a minimum price of 65% of list was reached at the end of 5½ years. For punched card equipment, the purchase price declined to a minimum of 45% of list for equipment still in production, 35% of list for equipment out-of-production but still available in the market, and 25% of list for equipment both out-of-production and no longer available on a used basis from IBM.

On October 1st, IBM declared by fiat that age is no longer a factor in determining the economic value of equipment to a customer. Instead, IBM pointed to

economic and technological change as the primary factors in determining the economic value of IBM equipment for its users. On that premise, IBM has frozen the purchase price to a renting customer of all its currently installed computers and punched card equipment at the value each achieved as of October 1, 1965.

A consequence of this action is that IBM has raised the sale price of its used data processing equipment in inventory to 100% of the list price for similar new equipment. Also, a punched card customer may well find, for example, that two 407 accounting machines at his installation, both with the same date of manufacture and both yielding the same performance, might have sale prices of $24,000.00 and $55,000.00 respectively . . . based on the fact that the former one has been in use at his particular installation for eight years while the latter was installed only a few months ago.

"OPTION-TO-PURCHASE" PLAN

Prior to October 1st, customers renting IBM equipment could obtain an "Option-to-Purchase" contract which allowed them to apply between 45% and 55% of the first year rental payments for their equipment toward the purchase price of the equipment. The fee for entering into this contract was the payment of 1% of the purchase price of the equipment ninety days prior to its installation.

Starting October 1st, IBM no longer offers this contractual arrangement. In its place, IBM now allows all customers renting its data processing equipment the opportunity to apply 40% to 60% (depending on the equipment) of the first year rental payments toward the purchase price of the equipment. The actual percentage of rental applied on each type of equipment has been extensively changed under the new plan. For example, under the previous plan, 45% of the first year rental on central processors and 55% on peripheral equipment was credited against the purchase price; under the new plan, the percentages are reversed.

Therefore, under the new IBM regulations for the purchase of rented equipment, the minimum purchase price of IBM rented data processing equipment installed after October 1, 1965, will be 88%–89% of the full list price (since IBM's purchase/lease ratio on most data processing equipment is roughly 50/1, one half of the first year's rental equals approximately 6/50th or 12% of the purchase price).

MAINTENANCE PRICES

IBM has announced sharp increases in maintenance charges for customers using certain purchased IBM equipment. For example, on January 1, 1966, maintenance charges on a purchased IBM 1402 card reader/punch less than three years old will be increased from $50.25 per month to $120.00 per month, an increase of 140%! This effectively changes the breakeven point on a decision to purchase versus rent this unit from just over 59 months to over 68 months . . . a 15% longer pay-back period for users with an IBM maintenance contract on this equipment. This increase has a stiff impact on IBM competitors offering IBM peripherals such as the 1402 as part of their product lines. Readers will recall that IBM now requires its competitors to purchase rather than rent such equipment.

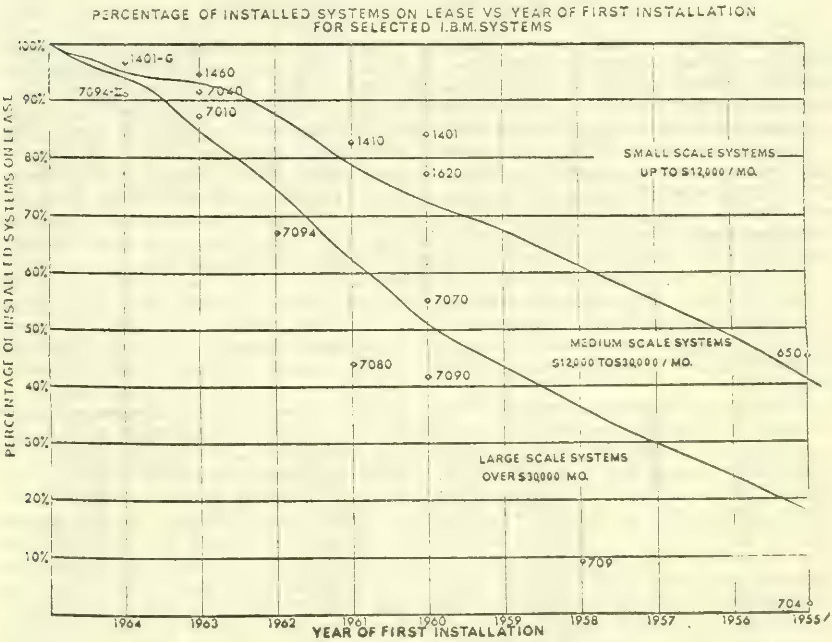
To reconcile IBM's declaration in its new purchase price policy that age has no effect on the performance value of its equipment, IBM has established a single monthly maintenance fee for each of its data processing units. Formerly maintenance charges increased with the age of the machine in three year cycles.

IBM has also increased maintenance charges for customers receiving maintenance on a time and materials basis. The hourly labor charge has been increased 20%, from $15 to $18 per hour. Overtime charges have been increased similarly.

IBM press announcement on the subject declared that "because of continuing improvements in IBM's maintenance and reconditioning programs, it is possible to provide equivalent performance levels in machines with different dates of manufacture." These improvements have apparently not come easily, for since 1963 IBM's monthly maintenance charges to customers with purchased equipment have increased 60% for punched card equipment and 100% for computers. Since these increases in maintenance charges have not been made with a concomitant increase in rental rates for computers and punched card equipment, IBM has been in effect increasing the equivalent purchase price of their equipment between 10%–20% during the last three years.

The new IBM announcement appears to be put one of a series of carefully planned moves IBM has been making during the last four years to control the per-

centage of its computer and punched card equipment being purchased. The previous increases in maintenance charges to customers with purchased IBM equipment, and the shortening of the period during which a percentage of rental payments could be applied to the purchase price from two years to one year, are examples of these moves. Their overall objective, of course, is to maintain IBM's profit goals in the years ahead. Three prominent reasons motivating these changes at this time are (1) the expected long market life of System/360, (2) the activities of purchase-lease-back companies, and (3) the used computer market.



LONG MARKET LIFE OF SYSTEM/360

As indicated in the chart below, the percentage of currently installed IBM computers purchased increased under the former "Option-to-Purchase" plan in rough proportion to their length of service on the market . . . taking into account that the *rate* of purchase was lower for small-scale systems and higher for large-scale systems. This is easily understood in light of IBM's former policy of reducing the purchase price of equipment with each year of service.

Since the System/360 is envisioned by IBM as being a series of computer systems actively marketed and in use for ten or more years, IBM is anxious to keep a high percentage of installed systems on rental so that they will provide highly profitable revenues to IBM during the latter half of their decade of use. IBM apparently reasons that customers likely to purchase their system in any case will do so by the end of the first year of use—reacting to the incentive of the 11% to 12% discount—rather than delaying for two or more years the decision to purchase. Customers not being able to make a decision to purchase by the end of the first twelve to eighteen months of use will probably continue to rent their 360 system indefinitely, since the purchase price on their aging equipment will remain fixed.

Two other factors that will discourage users of 360 equipment from purchasing are: (a) the rapid advances being promised in peripheral equipment, especially in the areas of printers, optical character recognition units, displays, and mass memories, and (b) the program compatibility between models of 360 make upgrading of the central processor to achieve greater processing capacity a relatively simple technical step . . . making customers wary of getting locked in at too low a level

by purchasing a processor which might be found to be underpowered for the application load required.

It is likely that under IBM's new plan between 80%–85% of System/360 users will rent their equipment for the long haul. Those that do purchase will put forth their purchase price within their first six to sixteen months of use of their system, suggesting that IBM will be receiving a generous share of income from purchased systems during '66 and '67, the two years of heaviest installation activity with its associated heavy marketing, training, and installation expenses.

PURCHASE-LEASE-BACK COMPANIES

Probably tne single most compelling reason for the timing of IBM's price changes has been the "purchase-lease-back" activities of companies such as Management Assistance, Inc., Boothe Leasing Corp., D.P.A., Inc., Cyber-Tronics, Inc., etc. During the past year these firms have been generating an impressive volume of business by arranging for computers and punched card equipment users (particularly the latter) renting equipment from IBM to purchase their equipment at the reduced prices allowed by IBM's former price policy. The "purchase-lease-back" firm would then, as their name implies, purchase the equipment from the user for the same price and lease it back to the user usually at substantial savings in rental costs. It is believed that the volume of IBM equipment purchased during the last twelve months by these companies is in excess of $40 million.

The effect on "purchase-lease-back' companies of IBM's new policy is likely to be a strong acceleration in their activities during the next year or so, since the purchase-lease-back arrangement for IBM equipment will never be more attractive than it is at the current time. In the next three to five years, however, if the IBM policy stands, a restriction in the growth of these firms is clearly indicated.

It is highly likely that because IBM's new policy has a direct adverse economic impact on "purchase-lease-back" companies, the policy will be challenged in the courts as an artificial measure designed to restrain the trade of independent companies purchasing and maintaining IBM equipment. Certainly, the elimination of IBM's former "Purchase-of-Rented" plan seems in strong contrast to the spirit behind the wording of the so-called IBM Consent Decree, the agreement drafted by the United States Justice Department and signed by IBM on January 25, 1956. This judgement, the requirements of which officially expire next January, required IBM to offer to sell to any customer renting an IBM tabulating or electronic data processing machine that equipment at a sale price "which should not be greater than the sale price for a new machine of the same type and model less 10% for each full year of age, computed from the date of first installation after original assembly or rebuilding, except that for machines of more than eight years the price may be more than 25% of such sales price." This agreement was binding only during the period of eighteen months from the signing of the judgement. However, since the judgement did direct IBM to be non-discriminatory in offering customers the opportunity to purchase as well as rent its equipment, its spirit is likely to be invoked in challenging IBM's new purchase policy.

Logically, IBM should be anxious to curtail the activities of "purchase-lease back" firms for two reasons. First, IBM loses profitable rental income on its data processing equipment, particularly punched card equipment, that is usually fully depreciated on its books. Second, since many of the "purchase-lease-back" firms provide their own maintenance service, or arrange for maintenance service through outside sources, IBM loses its close service relationship with its customers, thereby greatly lessening IBM's opportunity to upgrade the customer's equipment to a more elaborate punched card installation or to a computer. In fact, one "purchase-lease-back" firm reports that in over half of the punched card installations purchased by it which have subsequently upgraded to a computer, the computer was of non-IBM manufacture.

USED COMPUTER MARKET

The freezing of the purchase price of IBM computer systems raises the ceiling at which used IBM computers of the first or second generation will be able to enter the used computer market during the next two to three years. However, since even under the "Purchase-of-Rented" plan, IBM's purchase prices were well above that of the free market, little effect on the quantity or price of used computers is foreseen. The new IBM plan does, however, firmly squelch suggestions made by some EDP consultants that IBM might be planning a drastic reduction

in the purchase price of its second generation equipment in order to make a final "cash-in" on the 1400/7000 series prior to quantity deliveries of the System/360. The naivete of such assumptions in terms of IBM's market and profit goals is now clearly seen.

IBM has several further moves it can make if the percentage of its data processing equipment rented by its customers is not brought on target by the new policy. One step is to shift the purchase to rent ratio of its equipment upward, thereby increasing the purchase price of its data processing equipment without changing its monthly rental. IBM has made several purchase price changes on data processing equipment in the past, but is quite proud of the fact that only once in the recent past (in 1956, after signing the Consent Decree) did it ever change the rental price of some of its equipment. The second measure that IBM can take is to withdraw its "Option-to-Purchase" plan entirely, thereby allowing no application of paid-in-rental toward the purchase price of its rented equipment. Since the new "Option-to-Purchase" plan does not involve a contractual arrangement as did the previous one, IBM is free to make this change in the future with a minimum of thirty days notice to its customers.

Both these moves, of course, would offer some additional competitive price advantage to IBM competitors in the computer industry. However, this effect might well be outweighed by the additional profits to be realized by the rental income coming from a generous share of the 65% to 75% of the computer market IBM is expected to maintain command of in the 1970's.

MONTHLY COMPUTER CENSUS AS OF AUGUST 10, 1965

Manufacturer and name of computer [1]	Solid state ?	Average monthly rentals	Date of 1st installation	Number of installations	Number of unfilled orders
Advanced scientific instruments:					
ASI 210	Yes	2,850	April 1962	23	2
ASI 2100	Yes	3,000	December 1963	6	0
ASI 6020	Yes	2,200	April 1965	3	4
ASI 6040	Yes	2,800	July 1965	1	4
ASI 6050	Yes	3,000	October 1965	0	1
ASI 6070	Yes	3,500	October 1965	0	0
ASI 6080	Yes	4,000	January 1966	0	0
Autonetics:					
RECOMP II	Yes	2,495	November 1958	55	[2] X
RECOMP III	Yes	1,495	June 1961	14	X
Bunker-Ramo Corp.:					
BR-130	Yes	2,000	October 1961	170	10
BR-230	Yes	2,680	August 1963	14	1
BR-300	Yes	3,000	March 1959	40	29
BR-330	Yes	4,000	December 1960	35	[2] X
BR-340	Yes	7,000	December 1963	19	2
BR-530	Yes	6,000	August 1961	15	[2] X
Burroughs:					
205	No	4,600	January 1954	56	[2] X
220	No	14,000	October 1958	44	[2] X
E101-103	No	875	January 1956	163	[2] X
B100	Yes	2,800	August 1964	60	35
B250	Yes	4,200	November 1961	104	7
B260	Yes	3,750	November 1962	205	65
B270	Yes	7,000	July 1962	148	25
B280	Yes	6,500	July 1962	85	25
B300	Yes	8,400	July 1965	2	45
B5000/B5503	Yes	20,000	March 1963	39	11
Clary: DE-60/DE-60M	Yes	535	July 1960	325	3
Computer Control Co.:					
DDP-19	Yes	2,800	June 1961	2	[2] X
DDP-24	Yes	2,500	May 1963	66	4
DDP-116	Yes	900	April 1965	6	45
DDP-224	Yes	3,300	March 1965	8	22
Control Data Corp.:					
G-15	No	1,000	July 1955	328	[2] X
G-20	Yes	15,500	April 1961	26	[2] X
160/160A/160G	Yes	1,750, 3,400, 12,000	May 1960, July 1961, March 1964.	426	4
924/924A	Yes	11,000	August 1961	28	1
1604/1604A	Yes	38,000	January 1960	60	[2] X
3100	Yes	7,350	December 1964	24	35
3200	Yes	12,000	May 1964	76	3053
3300	Yes	15,000	August 1965	0	
3400	Yes	25,000	November 1964	12	20
3600	Yes	58,000	June 1963	42	11
3800	Yes	60,000	November 1965	0	20
6400	Yes	40,000	January 1966	0	3
6600	Yes	110,000	August 1964	4	10
6800	Yes	140,000	April 1967	0	1

MONTHLY COMPUTER CENSUS AS OF AUGUST 10, 1965—Continued

Manufacturer and name of computer [1]	Solid state?	Average monthly rentals	Date of 1st installation	Number of installations	Number of unfilled orders
Digital Equipment Corp.					
PDP-1	Yes	3,400	November 1960	60	2
PDP-4	Yes	1,700	August 1962	55	2
PDP-5	Yes	900	September 1963	112	4
PDP-6	Yes	10,000	October 1964	10	11
PDP-7	Yes	1,300	November 1964	14	55
PDP-8	Yes	525	April 1965	45	160
El-tronics, Inc., ALWAC IIIE	No	1,820	February 1954	24	[2] X
Electronics Associates, Inc.: 8400	Yes	7,000	June 1965	1	6
Friden 6010	Yes	600	June 1963	200	188
General Electric:					
115	Yes	1,375	December 1965	0	100
205	Yes	2,900	June 1964	28	15
210	Yes	16,000	July 1959	56	[2] X
215	Yes	6,000	September 1963	50	5
225	Yes	8,000	April 1961	145	3
235	Yes	10,900	April 1964	51	6
415	Yes	7,300	May 1964	62	75
425	Yes	9,600	June 1964	35	55
435	Yes	14,000	October 1964	11	20
625	Yes	41,000	December 1964	5	22
635	Yes	45,000	December 1964	5	26
General Precision:					
LGP-21	Yes	725	December 1962	130	[2] X
LGP-30	Semi	1,300	September 1956	400	[2] X
RPC-4000	Yes	1,875	January 1961	80	[2] X
Honeywell Electronic Data Processing:					
H-120	Yes	2,600	December 1965	0	160
H-200	Yes	5,700	March 1964	555	310
H-400	Yes	8,500	December 1961	122	8
H-800	Yes	22,000	December 1960	83	8
H-1200	Yes	6,500	February 1966	0	33
H-1400	Yes	14,000	January 1964	12	2
H-1800	Yes	30,000	January 1964	11	9
H-2200	Yes	11,000	October 1965	0	42
H-4200	Yes	16,800	February 1966	0	6
H-8200	Yes	35,000	March 1967	0	1
DATAMATIC 1000	No	40,000	December 1957	4	[2] X
IBM:					
305	No	3,600	December 1957	180	[2] X
360/20	Yes	1,800	December 1965	0	2,700
360/30	Yes	7,500	May 1965	55	2,350
360/40	Yes	16,000	April 1965	70	650
360/50	Yes	30,000	August 1965	0	300
360/60	Yes	48,000	August 1965	0	16
360/62	Yes	55,000	September 1965	0	5
360/65	Yes	49,000	January 1966	0	85
360/67	Yes	49,000	September 1966	0	7
360/75	Yes	78,000	November 1965	0	85
650	No	4,800	November 1954	270	[2] X
1130	Yes	850	November 1965	0	1,050
1401	Yes	4,500	September 1960	7,100	300
1401-G	Yes	2,000	May 1964	1,000	100
1410	Yes	14,200	November 1961	760	50
1440	Yes	3,500	April 1963	2,000	450
1460	Yes	9,000	October 1963	2,000	350
1620 I, II	Yes	2,500	September 1960	1,750	30
1800	Yes	3,500	December 1965	0	75
701	No	5,000	April 1953	1	[2] X
7010	Yes	22,600	October 1963	140	60
702	No	6,900	February 1955	8	[2] X
7030	Yes	160,000	May 1961	7	[2] X
704	No	32,000	December 1955	43	[2] X
7040	Yes	18,000	June 1963	108	22
7044	Yes	35,200	June 1963	55	8
705	No	30,000	November 1955	61	[2] X
7070, 2, 4	Yes	27,000	March 1960	352	8
7080	Yes	55,000	August 1961	73	1
709	No	40,000	August 1958	11	[2] X
7090	Yes	63,500	November 1959	56	4
7094	Yes	72,500	September 1962	135	15
7094 II	Yes	78,500	April 1964	77	30
ITT: 7300 ADX	Yes	18,000	September 1961	9	6

MONTHLY COMPUTER CENSUS AS OF AUGUST 10, 1965—Continued

Manufacturer and name of computer [1]	Solid state?	Average monthly rentals	Date of 1st installation	Number of installations	Number of unfilled orders
Monroe Calculating Machine Co.:					
Monrobot IX	No	[3] 5,800	March 1958	155	[2] X
Monrobot XI	Yes	750	December 1960	560	130
National Cash Register Co.:					
NCR-304	Yes	14,000	January 1960	26	[2] X
NCR-310	Yes	2,000	May 1961	46	1
NCR-315	Yes	8,500	May 1962	330	35
NCR-315-RMC	Yes	12,000	September 1965	0	75
NCR-390	Yes	1,850	May 1961	960	60
NCR-500	Yes	1,500	September 1965	0	200
Philco:					
1000	Yes	7,010	June 1963	16	2
2000-210 211	Yes	40,000	October 1958	21	2
2000-212	Yes	52,000	January 1963	0	2
2000-213	Yes	68,000	June 1965	0	1
Radio Corp. of America:					
Bismac	No	100,000	——— 1956	3	[2] X
RCA 301	Yes	6000	February 1961	600	12
RCA 3301	Yes	11,500	July 1964	33	22
RCA 501	Yes	14,000	June 1959	98	2
RCA 601	Yes	35,000	November 1962	5	[2] X
Spectra 70/15	Yes	2.600	November 1965	0	60
Spectra 70/25	Yes	5.000	November 1965	0	50
Spectra 70/45	Yes	9,000	March 1966	0	60
Spectra 70/55	Yes	14,000	May 1966	0	13
Raytheon:					
250	Yes	1,200	December 1960	170	10
440	Yes	3,500	March 1964	12	5
520	Yes	3,200	October 1965	0	8
Scientific Data Systems, Inc.:					
SDS-92	Yes	900	April 1965	15	40
SDS-910	Yes	2,000	August 1962	140	25
SDS-920	Yes	2,700	September 1962	88	15
SDS-925	Yes	2,500	December 1964	4	22
SDS-930	Yes	4,000	June 1964	54	25
SDS-9300	Yes	7,000	November 1964	11	8
Systems Engineering Labs:					
SEL-810	Yes	750	August 1965	0	8
SEL-840	Yes	4,000	October 1965	0	3
UNIVAC:					
I and II	No	25,000	March 1951; November 1957.	29	[2] X
III	Yes	20,000	August 1962	88	5
File Computers	No	15,000	August 1956	20	[2] X
Solid-State 80 I, II, 90 I, II, and Step	Yes	8,000	August 1958	310	[2] X
418	Yes	11,000	June 1963	26	12
490 Series	Yes	26,000	December 1961	55	27
1004	Yes	1,900	February 1963	2900	250
1050	Yes	8,000	September 1963	180	160
1100 Series (except 1107)	No	35,000	December 1950	13	[2] X
1107	Yes	45,000	October 1962	28	1
1108	Yes	50,000	July 1965	0	15
LARC	Yes	135,000	May 1960	2	[2] X
Total				28,415	11,911

[1] To avoid double counting, note that Control Data 160 serves as the central processor of the NCR 310. Also, many of the orders for the IBM 7044, 7074, and 7094 I and II's are not for new machines but for conversions from existing 7040, 7070 and 7090, computers respectively.

[2] X—no longer in production.

[3] Sold only.

Note: The number of electronic digital computers installed or in production at any one time has been increasing at a bewildering pace in the past several years. New vendors have come into the market, and familiar machines have gone out of production. Some machines have been received with open arms by users—others have been given the cold shoulder.

To aid readers of the EDP I&MR in keeping with this mushrooming activity, we compile and publish this monthly report on the number of general purpose electronic computers made by American based-companies which are installed or on order as of the preceding month. These figures included installations and orders outside the United States. We update this computer census monthly, so that it will serve as "box score" of progress in following the growth of the American computer industry, and of the computing power it builds.

In general, manufacturers in the computer field do not officially relaese installation and on order figures. The figures in this table are developed through a continuing market survey conducted by our research staff. This market research program develops a documented data file on over 80% of the computer installations in the United States. A similar program is conducted for overseas installations.

Comments on this census from informed readers will be welcomed.

STOCK MARKET REPORT ON SELECTED EDP FIRMS, SEPT. 20, 1965 TO OCT. 1, 1965

	1965 High	1965 Low	Sales in 100's	2 weeks High	2 weeks Low	Last	2 weeks Net change	2 weeks Percent change
New York Stock Exchange:								
Addressograph-Multigraph	61⅜	41⅛	4174	61⅜	52	56⅛	+4⅜	+8.45
American R. & D.	25½	17⅝	202	20	18¼	19¾	+½	+2.60
Burroughs	42½	24⅞	5654	42½	37⅜	40⅛	+2¾	+7.31
Control Data	64¼	30¼	4638	35¾	31	31¾	−3⅜	−9.61
Dura Corp	33⅛	19¾	98	24½	21¾	21¾	−2⅞	−11.68
Electronic Associates	27	16¾	635	23⅛	20¼	20⅞	−1½	−6.70
General Dynamics	46⅞	35	5874	46⅞	40¾	45½	+4	+9.64
General Electric	120¼	91	2705	120¼	111⅝	116⅞	+4⅞	+4.35
Honeywell	79¾	58¼	1666	79¾	71½	75	+2⅝	+3.63
IBM	517¼	404	584	517¼	503¼	507	−7¾	−1.51
International Telephone & Telegraph	63⅞	48¾	1239	55⅞	54	54⅛	−1¾	−3.13
Litton	118⅞	74⅝	1431	118⅞	108⅝	109⅛	−7⅛	−6.13
National Cash Register	91¾	74	784	81¾	75¼	75½	−1⅛	−1.47
RCA	47⅜	31	17858	47⅜	39⅝	44⅛	+4⅜	+11.01
Raytheon	34⅜	19	3714	34⅜	30	31⅛	−2½	−7.43
SCM	51⅝	16¼	31274	51⅝	32½	41⅛	+10⅜	+33.94
Singer	83¼	59	1025	66⅞	61¼	66	+1⅛	+1,73
Sperry Rand	16	11⅛	11284	16	13¾	15	+ ¼	+1.69
NYSE computer stock average							+0.40	+2.03
American Stock Exchange:								
ANelex	39	19¾	319	23	20½	21¼	−1⅝	−7.10
Bunker-Ramo	11¼	5⅞	379	7¾	7	7	−½	−6.67
Cal Comp	24	13	91	17¾	14¾	14⅞	−2⅜	−13.77
Clary	6⅛	3⅛	126	3¾	3⅛	3⅛	−½	−13.79
Computer Application	32¼	15¾	593	24¾	18⅛	23¼	+5⅛	+28.47
Computer Science	62¼	19⅝	1005	62¼	50⅝	59¾	+5¾	+10.65
Milgo Elec	12⅝	8¼	36	9¼	8½	8½	−¾	−8.11
Planning Research	33¾	12⅛	434	30⅛	26¾	28¼	+2¼	+8.65
Potter Instrument	10½	6⅝	110	9⅝	8½	9¼	−¼	−2.63
Amex stock average							+0.79	−0.48

	1965 High bid	1965 Low bid	Oct. 1 Bid	Oct. 1 Asked	2 weeks ago bid
Over-the-counter:					
CEIR	13½	7	11⅞	12⅛	12
Computer Usage	30¾	13¼	19¾	21¾	19½
Computer Control	17⅛	8	8½	9	10⅛
Digitronics	7¼	3⅞	6⅝	7	6⅞
Management Assistance	59	29¼	47¾	48¾	58¾
Scientific Data	44¾	31¾	35	35½	36

Appendix 6

Thursday, December 1, 1964

IBM Trims Rates For Overtime Use Of Rented 360's

BASIC MONTHLY CHARGE KEPT UNCHANGED ON ITS NEW LINE OF COMPUTERS DUE IN 1965

RCA TO ALLOW UNLIMITED USE

(By Stanley Penn, Staff Reporter of the Wall Street Journal)

New York.—International Business Machines Corp. has reduced the overtime rental rates for its new line of System 360 computers announced last April.

At least two other computer makers—Honeywell, Inc., and Control Data Corp.—have reduced rental charges to customers who use their computers for extra-work-turn operations, in moves apparently reflecting stiffening competition in the electronic computer field.

And last night Radio Corp. of America disclosed it will provide a single charge for unlimited use on its new computers that it will rent to customers. The new RCA computers will be announced next week.

Currently, RCA extra-work-turn rates are about comparable to the new lower IBM rates for overtime use. RCA said it was establishing the single charge because of the changing nature of the computer business. The company noted that more customers are using computers for communications purposes, requiring that the machines perform on different schedules around the clock.

IBM, the nation's biggest computer maker, said the basic monthly charge for the System 360 for 176 hours is unchanged. But for each hour the computer is used after that, the rental rate has been cut to 10% of the basic hourly rate from the existing 30%.

Most computers are rented to customers and not sold outright. IBM didn't make any changes in the outright sale price of the System 360 computers.

IBM's reduction on the overtime rates isn't nearly as significant as a cut in the basic monthly rate would have been. However, the move is regarded as the most dramatic example so far of IBM's determination to keep its traditional share of the computer market in the face of growing pressure from competitors.

The cut in the overtime rental rate could mean large savings to customers. It will also mean less profit per machine to IBM.

IBM said it notified Oct. 14 all customers—Government, business and others—of the new overtime rates. Customers who ordered the 360 computers before then will get the benefits of the lower rates.

Deliveries of the new System 360 computers are scheduled to begin in the third quarter next year. These will be the small machines. The large machines in the new system will start going to customers in the first quarter of 1966.

Honeywell said it reduced second-shift rental costs to 30% of the basic rate from 40% a couple months ago. "We will match competitive schedules in the future as necessary to insure that our users are obtaining the most computer per dollar."

Univac division of Sperry Rand Corp. said it is "studying the situation," but hasn't reduced any overtime rates.

Control Data Corp., Minneapolis, said it eliminated extra-shift charges for some of its computers including the large-scale 1604 about last July 1.

General Electric Co. last week said it hadn't reduced overtime rates for computers it rents.

In explaining the lower overtime rates, IBM said that at the time it announced the new System 360 last April it didn't have much information on the "usage patterns" for these machines. Now, however, the company has built up a backlog of orders for the machines. IBM has learned how often each month the customers for the 360 machines plan to operate them. This has made it possible to lower the overtime rate "to reflect the improved price performance of the system," as compared with IBM's predecessor line of computers, the company said.

In the industry, other interpretations were offered. One source speculated that IBM was trying to make it more attractive to users of existing IBM machines to switch over to the new line. The old line of IBM computers currently in customers' hands retains the existing 30% overtime rates for the rented machines.

A Government source said the IBM move could be a response to the Government's decision to buy more computers outright and do less renting. The Government has done this in the belief it will save money in the long run. A Government source speculated that the lower overtime rate is IBM's way of urging Government purchasing people to reconsider their policy and to rent the machines once again instead of buying them.

There are advantages to computer makers when customers rent the computers. There is the assurance of steady income coming in monthly to the manufacturers. Also, a Government source said, there might be less tendency to obtain new computers if appropriations have to be made to buy them outright. "It's easier renting a machine, or it seems that way," the source said. "All you do is send the old machine back and get a new one."

The savings to the Federal Government alone on the lower overtime rates could be substantial. As of last June 30, the Government was using 1,767 business-type computers. Of that amount, only 17% were in service less than 176 hours a month, or less than the equivalent of a normal 40-hour week. The Government, the single biggest user of computers, accounts for 10% to 20% of all computers in the hands of customers around the nation.

Appendix 7

[The Wall Street Journal, Monday, April 26, 1965]

IBM Adds 3 System 360 Computers, Drops 5 From Line in Another Pre-Delivery Change

(By a Wall Street Journal Staff Reporter)

New York.—System 360, the powerful new family of computers announced by International Business Machines Corp. a year ago this month, has undergone

another major modification, even before a single model has been delivered to a customer.

Over the weekend, the world's dominant computer maker introduced three large-scale models that "supersede" five previously announced models for which IBM had already taken orders. Two of the five computer systems that the company has thus dropped from the line were presented publicly only last month. The replacements, IBM says, are faster and more powerful, with more data storage. Moreover, the monthly rentals and purchase prices of the central computing units of the new systems are said to be slightly lower.

System 360 has experienced such radical technological additions and changes in the last year that it's impossible to name a model whose claimed abilities haven't been increased substantially. Last April, when IBM held an all-day news conference in Poughkeepsie, N.Y., to make what some people called the most important commercial innovation in the brief history of the computer, Chairman Thomas J. Watson, Jr., listed six members of the System 360 family, with 19 variations in the sizes of their data storage, or memories.

Today, after taking into account the latest revisions in the line, System 360 comprises eight models, with 29 choices of memory.

VERSATILITY EXPANDED

The original announcement included 44 devices for data input and output, such as tabulating card punches and readers, magnetic recording tape equipment and optical character readers. Now there are 65, representing variations not only in function but also in speed, capacity and price.

System 360, in all its models and "configurations," as the industry terms the varying combinations of equipment that make up related systems, is more than IBM's attempt to take a giant step forward in technology. It is also the company's answer to the broad range of equipment brought out over the past year by its competitors, who have been nibbling away at IBM's reputed 70% share of the business.

General Electric Co., Radio Corp. of America and Honeywell, Inc., also have unveiled computer families and Sperry Rand Corp., Control Data Corp., National Cash Register Co. and Burroughs Corp, have made major product introductions.

Because of the intense competition, the substantial changes made in System 360 designs in the past year raise this question: Was its announcement on April 7, 1964, premature and, made for competitive reasons before development was completed? The answer, IBM replies emphatically, is 'No."

"We had gone through product tests, and we had built models of the computers that were announced," John R. Opel, vice president, marketing, of the data processing division, said in an interview. "We don't make commitments we don't plan to fulfill."

Improvements come faster

"The "technology cycle" is getting shorter and shorter, Mr. Opel continued. As a result, System 360 was planned as an "architecture" "within whose limits technological improvements could be made without affecting the way the computers were operated or the way that customers applied computers to their own problems. IBM's latest announcement represents "three or four technological improvements that give so much better a cost-performance ratio that they obsolete what we originally announced," Mr. Opel said.

"We're glad to make these improvements," he declared. "There are going to be more of them, and as soon as we can get it done we'll do it.' '

The changes, a spokesman added, won't affect the originally scheduled delivery dates. Orders for new computers usually are taken for delivery 12 months later or more.

The original System 360 computers, ranging upward in size, were the Models 30, 40, 50, 60, 62 and 70. Last August, IBM said it would offer a custom-designed super computer, the Model 92, more than twice as fast as the Model 70 and priced in the $5 million-and-up class. In November, the company announced the smallest member of the family, the Model 20, for which monthly rentals range up from $1,280 and purchase prices from $62,710. Improvements and added features for all these machines were announced from time to time.

Then, on March 4, IBM added the Models 64 and 66, variations of the 60 and 62 and designed specifically for time-sharing applications, in which one com-

puter serves many users simultaneously. That brought the total number of models to 10.

Models 65, 67 and 75 are new

The newest members of the family, however, are the Model 65, which replaces the Models 60 and 62; the Model 67, which replaces the *seven-week-old 64 and 66*, and the Model 75, which replaces the 70.

The monthly rental range for the Model 65 is $40,000 to $65,000, and the purchase price range is from $1.8 million to $3 million, depending on the input and output equipment utilized. Customers who order Model 60s and 62s will get them, beginning in the third quarter a, spokesman said. These machines will be converted to Model 65s when deliveries of that model begin early next year.

Customers who have ordered Model 70s will get Model 75s instead, beginning in the last quarter of this year as scheduled. Monthly rentals will range from $50,000 to $80,000 and purchase prices from $2.2 million to $3.5 million.

The Model 67's prices will be roughly comparable to those of 64 and 66, for which monthly rentals ranged from $45,000 to $250,000, under special customer bidding arrangements. The University of Michigan had announced an order for a Model 66 only two days before it was supplanted by the Model 67.

The first deliveries of System 360 computers will be of Models 30 and 40, and they are scheduled during the current quarter. One Model 40 has been delivered to IBM's own data-processing center in New York.

In addition to the three new computers, IBM announced a high-capacity disk memory unit, the Model 2314, which can store up to 207 million characters of information. It will be used in systems requiring rapid access to great quantities of information on a random basis, such as airlines reservation and customer accounting for public utilities. The new memory alone sells for $252,000 or rents for $5,250 a month.

Appendix 8

PARTIAL LISTING OF IBM 360 SERIES MODEL ANNOUNCEMENTS, WITHDRAWALS AND REPLACEMENTS

Original models [1]	Subsequent models [1]	Date introduced [2]	Date withdrawn [2]	Replaced by	Date replaced
360/30		April 1964	November 1964	360/30F	See below.
360/40		do	August 1965	360/44	Do.
360/50		do			
360/60 and 360/62		do	April 1965	360/65	Do.
360/70		do	do	360/75	Do.
	360/90	May 1964	August 1965	360/92 [3]	Do.
				360/91J [3]	Do.
				360/94 [3]	Do.
				360/95 [3]	Do.
				360/91K	Do.
				360/91L	Do.
	360/92 [3]				
	3929 export version.	August 1964			
	360/91J [3]	do			
	360/94				
	360/30F	November 1964			
	360/20	do			
	360/64 and 360/66.	March 1965	April 1965	360/67	Do.
	360/65	April 1965			
	360/75	do			
	360/67	do			
	360/44 [4]	August 1965			
	360/95 [3]	August 1965			
	360/85	September 1965.			
	360/91	January 1966			
	360/91J	(See above)			
	360/91K	January 1966			
	360/91L	do			

[1] References are to main frame designations only. Numerous optional combinations of main frame equipment and peripheral equipments are possible.

[2] References indicate date of 1st public announcement or withdrawal by IBM, or, indicate, to the best of your knowledge, date model was first proposed by IBM to a customer.

[3] As indicated at pages 8 and 23, despite many proposals by IBM of models 360/90 360/91, 360 94, 360/95 and 360/91J from May 1964 to a published rumor of Dec. 15, 1965 that all 360/90 group models had been withdrawn from further marketing, IBM on Jan. 18, 1966 at last publicly announced the 1st of the group as 360/91J, 360/91K and 360/91L.

[4] Note: Specially introduced to compete in scientific market.

Introduction

1 SUMMARY

System/360 is the "brand name" for IBM's extensive third-generation family of central processors, storage modules, peripheral devices, and supporting software. Noteworthy characteristics of the System/360 include:

The "universality" concept—a single line of equipment designed to handle widely varying types and sizes of computer workloads.

The high degree of program compatibility, both upward and downward, among most of the processor models.

The wide range of input-output and storage devices.

The numerous arithmetic modes and data formats, and the resulting complexity of machine-language coding.

The emphasis upon software support through integrated operating systems, now offered at three different levels.

Solid-Logic Technology, IBM's name for the "hybrid" electronic circuitry used in the System/360, which is a compromise between earlier solid-state techniques and true monolithic integrated circuits.

The System/360 constitutes the "third generation" of equipment from the leading computer manufacturer. As such, it is now the primary standard for comparison in most computer selection studies, and it is important for every computer user to develop a good understanding of its characteristics, performance, strengths, and weaknesses. This comprehensive report will help you to gain that basic understanding and will serve as a continuing reference source.

The format of this report is designed to present and analyze all the facts about the System/360 in a way that will make it easy for you to locate and study the material you require, while placing proper emphasis upon the similarities and differences among the various models. This coverage consists of a general Computer System Report (behind Tab 420) which analyzes the concepts, hardware, and software that are common to all System/360 models, and individual subreports (behind Tabs 422 through 428) which report the characteristics, performance, and pricing of computer systems using each of the System/360 processor models. (System/360 Models 20 and 67 make use of specialized software, which is therefore described within the individual subreports for these models.)

For the same purposes of clarity and reader convenience, this Introduction is divided into six independent sections, each of which describes and (where pertinent) analyzes some particular facet of the System/360. Each section is independent and can be read as your needs and interests warrant. The six sections are:

1 Summary
2 System/360—the First Year
3 Data Structure
4 Hardware
5 Software
6 Compatibility.

2 SYSTEM/360—THE FIRST YEAR

As announced on April 7, 1964, the IBM System/360 consisted of 6 program-compatible central processors spanning a 50-fold range of internal processing speeds, 44 new and previously-announced peripheral devices, and a comprehensive package of language processors, utility routines, and control programs called the Operating System/360. IBM announced that "the System/360 marks the achievement of a truly all-purpose computer that can solve any type of data-handling problem with greater speed and efficiency than ever before."

Unquestionably the System/360, as originally announced, did offer an unprecedented range of processing speeds, storage capacities, and input-output equipment, and it spanned a broader range of potential applications than any previous computer system. Nevertheless, it soon became apparent that there were some significant weaknesses in the originally-announced line of hardware and software, as noted in last year's *AUERBACH Standard EDP Reports*, analysis of the System/360. A brief chronology of the announcements that have changed the complexion of the System/360 since April 1964 will show how IBM has endeavored to correct these weaknesses and to fill out and strengthen its overall product line.

August, 1964: IBM announced the System/360 Model 92, an ultra-high-performance computer "more powerful than any computer now available." IBM said it would enter into special contracts to build Model 92 computers based on customers' particular needs. Although Model 92's instruction repertoire and data format are similar to those of the smaller System/360 models, it will not be program-compatible with them because Model 92 lacks facilities for decimal arithmetic.

October, 1964: The first public demonstration of a working System/360 (a Model 40) was featured at the Business Equipment Exposition and Conference in Los Angeles.

October, 1964: IBM announced a series of new Compatibility Features—hardware-software combinations called "emulators"—to permit various models of the System/360 to execute programs written for the following older IMB computers: 1410, 7010, 7070, 7074, 7080, 709, 7040, 7044, 7090, 7094, II. (More recently, the 1620 was added to the list.) The only previously-available Compatibility Features enabled the smaller System/360 models to execute IBM 1401, 1440, or 1460 programs. The new emulators represented IBM's answer to widespread complaints from users of its other second-generation computers about the difficulties involved in reprogramming for the System/360.

November, 1964: IBM announced the System/360 Model 20, a small-scale, business-oriented computer designed primarily for small companies that are considering a step upward from conventional punched-card accounting machines. Announced along with Model 20 were the 2560 Multi-Function Card Machine, a 500-card-per-minute punch, and several other new peripheral devices. Model 20 extends the System/360 range downward into new marketing areas, but its degree of compatibility with the larger System/360 models is limited by its much smaller instruction repertoire, its limited core storage capacity, and its different method of handling input-output operations.

December, 1964: IBM advanced the scheduled date for initial customer deliveries of Model 30 and 40 systems from the third quarter to the second quarter of 1965. Delivery dates for Models 50 through 70 were also moved up. The advanced delivery dates, "made possible by accelerated production at IBM manufacturing facilities," were IBM's response to vigorous complaints about the long lead time between announcement and scheduled deliveries of the System/360.

December, 1964: IBM reduced the extra-usage rental rate for most System/360 components from 30% to 10% of the hourly rate for prime-shift use. The reduced extra-usage rate applies to all units with model numbers in the 2000 series (and the 1302 Disk Storage Unit was concurrently redesignated the 2302). This very significant reduction, which can have a major effect upon rent-versus-buy decisions, was IBM's response to the elimination or great reduction of extra-shift rental charges in several competitive computer lines.

January, 1965: IBM announced a 33 per cent increase in internal processing speed of the System/360 Model 30 through reduction of its core storage cycle time from 2.0 to 1.5 microseconds. Concurrently, the 2400 Series Magnetic Tape Units were speeded up from 22,500 to 30,000 bytes per second (Model 1) and from 45,000 to 60,000 bytes per second (Model 2); the 90,000 bytes-per-second speed of the Model 3 units remained unchanged. These speed increases helped to keep the performance of the System/360 in line with that of the program-compatible RCA Spectra 70 computer family, announced in December, 1964.

February, 1965: The IBM 1130 was announced as a desk-size computer designed primarily for individual use by scientists and engineers. The introduction of the 1130, which bears little resemblance to the System/360, was IBM's first clear indication that the System/360, even in extended or restricted versions, is not practical for every type and size of computer application.

February, 1965: IBM announced a complete restructuring of software support for the System/360. To meet complaints that the Operating System/360 required too much core storage and peripheral equipment to perform its impressive functions, while the facilities of the Special Support System (the only previous alternative) were far too restricted, IBM committed itself to the gigantic task of producing three different levels of software support: the Operating System/360, Basic Operating System/360 (BOS), and Basic Programming Support (BPS). Table V shows the facilities offered at each level and their scheduled delivery dates.

March, 1965: IBM announced two more additions to the System/360 line: the time-sharing Models 64 and 66. Models 64 and 66 featured an associative memory

to facilitate dynamic relocation of programs and a channel controller to permit flexible interconnections among the system components. The two time-sharing systems used the standard System/360 instruction repertoire plus additional instructions to direct the time-sharing features. Announced as non-standard models to be offered only through special proposals, the time-sharing systems represented IBM's response to the success of General Electric and other manufacturers in winning contracts for multi-console, time-sharing applications, where the System/360 as originally announced had been weak.

March, 1965: The 2870 Multiplexor Channel was announced, providing the capability to connect a large number of low-speed input-output devices to the larger System/360 models. Previously, the lack of Multiplexor Channels for the larger models had seriously restricted upward compatibility and made it almost mandatory to use a Model 30, 40, or 50 processor in conjunction with the larger processors for control of punched-card, printer, and/or data communications operations.

March, 1965: IBM announced the 2260 Display Station, a low-cost, buffered, cathode-ray-tube terminal for remote or local displays of alphameric data. An optional keyboard permits convenient man/machine communication. Concurrently, the more expensive 1015 Inquiry Display Terminal, which featured a self-storing dark-trace cathode ray tube, was dropped from the System/360 product line.

March, 1965: IBM demonstrated the 1401 Compatibility Feature for the System/360 Model 30 at its Endicott, New York facility. A wide variety of user-submitted 1401 programs were run on the System/360 with relatively few difficulties and, in most cases, at significantly higher speeds than on the original 1401. The practicality of the all-hardware, stored-logic approach to 1401 compatibility used in the Model 30 was convincingly demonstrated.

April, 1965: IBM completely restructured the upper half of the System/360 line by adding three new models and dropping five others. Model 65 superseded original Models 60 and 62, Model 75 superseded Model 70, and Model 67 superseded the just-announced, time-sharing Models 64 and 66. Models 65 and 75 offer significantly higher processing speeds at lower prices than their predecessors, indicating that the principal purpose of the restructuring was to bring the price/performance ratios of the larger System/360 models more closely into line with the offerings of competitors. (Meanwhile, IBM indicated that the design of the Model 92 was being "reevaluated," and that no performance details would be released until redesign of the Model 92—or its successor—had been completed.)

April, 1965: IBM announced the 2314 Direct Access Storage Facility, the 2415 Magnetic Tape Unit, and the 2540 Card Read Punch. The 2314, a multidrive, replaceable-cartridge disc storage unit, is the seventh distinct type of auxiliary storage in the System/360 line. The 2415, a low-speed, economy-model tape unit, provides magnetic tape capabilities for the System/360 Model 20 and makes it IBM's lowest-priced tape system. The 2540 supersedes the widely-used 1402 Card Read Punch and provides increased punching speed (300 cards per minute) and a number of detail improvements.

April, 1965: Initial customer deliveries of the System/360 were made. IBM announced that more than 1,000 System/360's will be delivered by the end of 1965, and that deliveries will reach a rate of 35 systems per day in mid-1966.

July, 1965: IBM underlined the steadily increasing importance of data communications applications by announcing eight new communications devices. Most significant are the 2703 Transmission Control, which links up to 176 communications lines to a System/360, and the 2712 Remote Multiplexor, which can multiplex data from as many as 14 remote, low-speed terminals over a single high-speed line to a computer.

August, 1965: IBM made doubled data rates available for all of the 2400 Series Magnetic Tape Units through a recording technique called "phase encoding," which permits 1600 bytes per inch to be recorded on standard half-inch tape.

August, 1965: IBM announced the System/360 Model 44, a processor especially designed for scientific and process control applications. Model 44 features high-speed binary arithmetic, a built-in single-disc storage drive, and up to 131,072 bytes of core storage; it cannot be equipped with decimal arithmetic facilities or Selector Channels.

Appendix 9

INTERNATIONAL BUSINESS MACHINES CORP.,
Armonk, N.Y.

NOTICE TO OUR CUSTOMERS—NEW IBM MARKETING PLANS

The following changes in our marketing plans go into effect October 1, 1965.

NEW WAY FOR RENTAL CUSTOMERS TO PURCHASE

We are replacing our Purchase of Installed and Purchase Option Plans and combining features from both into one program. Effective October 1, 1965, all IBM data processing equipment types (except some 650, 700, and Education Plan units) are automatically under the new plan. The highlights are:

A percentage of up to the first twelve Monthly Availability Charge payments (from October 1, 1965, forward) for installed equipment can be credited against the purchase of the IBM equipment without the need for a 1% deposit.

Under this plan, the option credits can be applied to your purchase of the machine as long as it remains on rent and installed with you.

The price at which you can purchase IBM equipment will be the then current standard purchase price, less the applicable option credits accrued on that equipment.

You may transfer accrued option credits on System/360 base units and apply them against the purchase of subsequent System/360 base units at your election by depositing one percent of the purchase price and completing the Option to Transfer Agreement before installation of the initial units.

DIRECT PURCHASE

If you wish to order your equipment on a purchase basis, you now have greater assurance that your request will be met through IBM's expanded purchase concept. As of October 1, 1965, we will offer for direct purchase not only new and renovated IBM equipment but also used equipment. Because the distinction between new and used is not related to the true economic value of a particular machine to a customer, all equipment will be offered for sale at the same price and under the same warranties. When a unit is not newly manufactured, it will be so identified in the Agreement for Purchase.

PRIOR PLAN AND AGREEMENTS

If you have signed a Purchase Option Agreement prior to October 1, 1965, you will have until November 1, 1965, to determine if you want to continue under the prior plan. If you decide to terminate the prior plan before November 1, 1965, the unexpired portion of the one percent Option Deposit as of October 1, 1965, will be credited to you.

The October 1, 1965 purchase price developed under the prior Purchase of Installed Plan becomes a constant for your IBM equipment on rent as of October 1, 1965. Assuming no changes to that equipment, under this plan it will stay at that same price for purchase by you as long as it remains on rent and installed with you. The purchase price of such an installed unit will be the lower of the October 1, 1965, price or the New Option to Purchase price. Option credits do not apply to this prior plan constant price.

IBM MAINTENANCE SERVICE

An adjustment to our maintenance service prices is also being made. You will receive details separately if you are a maintenance service customer.

Although all marketing plans such as these are subject to change, you can be assured that you will have reasonable notice of changes such as duration of option accrual period, withdrawal of option credits, and termination of the program to purchase at the October 1, 1965, constant price.

Appendix 10

Partial list of IBM offers of Educational Discounts and Gifts in recent years.

University of California - the largest single university in the United States with operations on several campuses, including the following:

1. University of California at Riverside

6/3/65	60-100% discount	7040
	60% discount	360/XX

2. University of California at Davis

10/9/63	60% discount	7040 & 7044

3. University of California at San Diego

6/15/65	100% discount	7090
	substantial discount	7094-II to replace previous substantial 7040 to be followed by 360/92 at 60% discount plus extra

4. University of California at San Francisco, Medical School

6/4/65	Substantial discount	1440
	Substantial discount	360/30

5. University of California - Berkeley Campus

11/12/65	Substantial discount	7094/7040

6. University of California at Santa Barbara

12/3/65	Substantial discount	360/40, /50
	60% discount	360/40, /65 to
	60% discount	360/50, /65 later

7. University of California at Irvine

9/65	60-100% discount	1410/1440 Remote terminals

(Note: "Nick-named" UCIBM, SCIENCE, Volume 148, P. 764, May 7, 1965)

8. University of California at Livermore (Lawrence Radiation Laboratory) (AEC)

11/12/65	Substantial discount	2 - 7094
	Substantial discount	2 - 1401
	Substantial discount	1 - STRETCH
	Extra special discount	360/90 Group

9. University of California at Berkeley (Lawrence Radiation Laboratory) (AEC)

11/12/65	Substantial discount	2 - 7094
	Substantial discount	7090
	Substantial discount	7044
	Substantial discount	360/90

10. University of California -- Los Alamos Scientific Laboratory (AEC)

11/22/65	Successively lower prices	2 - 360/70 and 360/92
		360/75 and 360/92

11. University of California at Los Angeles (UCLA)

UCLA Central Computing Facility

12/7/65	60% discount with buybacks	7094-II/1401
	60% discount	360/92
	Special deal	360/40

UCLA Health Science Computing Facility (NIH funded)

12/7/65	Special discounts	7090/7040, 1410, 1401
	60% discount	360/65
	Special discount	360/40 (ARPA funding)
	100% discount	360/40 (Alpine system)

Western Data Processing Center (WDPC) (IBM-owned)
(Operated by IBM in free UCLA facilities)

7/65		7094, 7040
		4th--360/40 (bait for 3 360/40s noted above)

Southern Research Triangle

1. University of North Carolina

12/10/65	Substantial discount, (Note: IBM leased land from triangle)	360/67

2. Duke University

6/4/65	60% discount	7040
	35% discount	360/50 and
	45% discount	360/75

3. North Carolina State

State University of New York - second largest university system in United States, has 58 operating units, including the following:

1. Cornell University

	Extra special discount	7090

2. NYSU at Buffalo

12/6/65	Substantial discount	360/67

3. NYSU at Stonybrook

12/6/65	60% discount	7040 (11/8/63)
	Substantial discount	360/70

4. NYSU School of Engineering

12/6/65	Substantial discount	360/30
	Free time	360/50

5. NYSU Courant Institute, New York City

7/65	60% discount	7094
	45% discount	360/30 (6/2/65)
	100% discount	360/70 (6/65)

6. NYSU, Uptown Campus, New York City

7/65	60% discount	1620
	replacement	360/30
	free use	360/40, /50
	offered	on IBM Data Center

Massachusetts Institute of Technology (M.I.T.)

1. MIT Computation Center ("to serve MIT and 51 other cooperating colleges and universities in New England", DATA PROCESSING MAGAZINE, September 1965)

9/65	Significant discount	360/67 time-sharing

2. MIT Civil Engineering Laboratory (ties in with 1 above)

10/4/65	Significant discount	360/40

3. MIT Nuclear Group

12/13/63	60% discount	7044

4. MIT Physics Group

12/13/63	60% discount	7044
7/6/65	Unknown	360/40
12/6/65	100% discount	360/65
	100% discount	2 - 360/67

Massachusetts Institute of Technology (Cont.)

5. MIT Lincoln Laboratory (operated by MIT for USAF)

7/5/65	unknown discount	(7094-II (360/40 (360/62 or (360/65 (dual 360/67 later

Group Comprising Midwest Universities Research Association (MURA) - reference news releases by Argonne National Laboratories, 10/21/64, under a new tripartite management comprising representatives of Midwestern Universities Research Association (MURA), Associated Midwest Universities (AMU), the University of Chicago and the Laboratory itself)

1. Iowa State College

12/10/65	significant discount	(360/40 to (360/65 (360/44

2. Purdue University

6/65	30% discount	7094/1401 and
10/29/63	20% discount	7044 and
	60% discount	1620
1/65 to	20% discount	360/62, /50 then
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5. State University of Iowa

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11. Northwestern University

12/18/63	60% discount	7094/7040

12. Michigan State University

13. University of Michigan

14. University of Kansas

15. University of Notre Dame

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July 1965 Carnegie Institute of Technology

	100% discount		(STRETCH, then (360/66, then
	Priced to get under CDC	Jan. '65 to Apr. '65	(360/91, then (360/66M, then (360/67

Stanford University

8/10/65	100% discount	1620
12/7/65	35% discount	360/50
6/7/65	Priced to get under CDC (50%-60%)	360/67, /75 360/92

6/4/65	Illinois Institute of Technology (IITRI)	50% plus IBM SBC buyback	7094/1401
12/65	University of Texas (T. J. Watson, Jr. - personal)	45-55%	360/75 360/91
12/6/65	Brown University	60% 20%	7070/1401 360/50
11/20/65	Georgia Institute of Technology	substantial	360/67
2/19/64	University of Arkansas	60%	1401/7090
10/25/63	University of Alaska	60%	1620
3/2/64	University of Louisville	60%	1620 w/1311
1/21/64	Manhattan College (Bronx)	60%	
3/13/64	Manhattan College (Riverside)	60%	1620
11/7/63	Milwaukee School of Engineering	60%	1620
8/18/64	Newark College of Engineering	60%	1620
2/16/64	Wisconsin State College	60%	1620
2/27/64	University of Omaha	60%	1620
12/10/65	" " (plus tie-in to IBM Data Center)	significant	360/30
2/12/65	University of Florida	20-45%	360/XX
5/65	University of Alaska	(components) 20%	360/40
3/65	University of Oregon	(peripheral) 20%	360/50
2/18/64	" "	60%	7040
6/3/65	University of Arizona	40%	360/60
5/18/65	Florida State University	45%	360/65
12/7/65	University of Nebraska	35% 20%	360/50, 360/65 7040
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4/7/64	San Jose State College	20%	7040
5/25/64	Yale University	60%	7040 & 7094-I ARPA

3/64	University of Washington	60%	7094/40
3/26/64	Florida Atlantic University	60%	all equipment
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Switzerland			
11/27/63	OBTG, University of Commerce, St. Gallen	60%	1410
Scotland			
12/63	St. Andrews University	50% cost of installation	1620
Australia			
4/65	University of New South Wales	60%	1620
Israel			
6/3/65	Weizmann Institute	60%	1302
6/3/65	Tel Aviv University	35%	360/40
Norway			
8/65	University of Bergen	30%	360/44
Australia			
6/4/65	University of New South Wales	60-70%	360/50
6/4/65	Australian National University	40%	360/50
England			
8/3/65	University College, London	45%	360/62
Germany			
6/3/65	Deutsches Rechenzentrum	45%	360/75 or up
Holland			
11/30/63	Institute for Applied Mathematics, University of Nejmegan	60%	7040
Switzerland			
11/1/63	ETUL, Lausanne	60%	7040
Australia			
6/4/65	Melbourne University	83%	7044

Germany			
3/19/64	Deutsche Riektranen, Hamburg	60%	7044/1401
India			
	Indian Institute of Technology	60%	7044/1401
Denmark			
3/64	Danish Technical University	5 years rent free	7090
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6/3/65	Imperial College, London	100%	7090
Germany			
11/6/63	KFA, Juelich	80%	7090
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6/4/65	Osaka University	100%	7090
	Tokyo University	60%	7094-II, 7040 and 1460
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4/29/64	Space General Corporation, Davis	60%	7040 & 7044
	Brookings Institute, Washington D.C.		7040

Appendix 11

NATIONAL AERONAUTICS
AND SPACE ADMINISTRATION,
Washington, D.C., December 7, 1965.

MR. WILLIAM C. NORRIS,
President, Control Data Corporation,
Minneapolis, Minn.

DEAR MR. NORRIS: You will recall that when we conferred in early October on the computer procurements for the real time computer complex at Houston, I indicated my desire for the National Aeronautics and Space Administration to undertake appropriate steps to improve the exchange of information between NASA and the computer industry, and to increase competition throughout the industry on future procurements of large-scale, general purpose computing systems. As a result of our discussions, an ad hoc committee was formed to review this entire matter and to recommend a plan of action for accomplishing this objective. The committee has completed its work, and we are prepared to move forward.

As an initial step, we would like to convene key corporate officials of the principal companies involved in the manufacture of new generation computer systems, in order that we might outline our plans to you and provide an opportunity for an exchange of views. We have scheduled a meeting for this purpose on Tuesday, December 21, 1965, in the Program Review Center (Room 70059) of the NASA Headquarters Building, 400 Maryland Avenue, S.W., Washington, D.C.

We have planned this industry briefing in two parts. The morning session from 10:00 a.m. to 12:00 noon will concern itself with a review of our policy, intentions, and future plans to increase competition. The afternoon session, from 1:30 p.m. to 4:30 p.m., will deal with advance information concerning specific computer procurements which NASA is planning to undertake in the immediate future.

We hope it will be possible for you to attend the morning session, and to participate in whatever portion of the afternoon session you feel would be of interest. You might want to have one or two additional company representatives join you, since the briefing should be of interest both to your sales and technical personnel. In view of the number of companies participating, and the limitations on space, it is requested that not more than three representatives attend from each company.

I would like to have you and any senior officials who accompany you join me for lunch, following the morning session. This will provide an opportunity for me to meet with the senior executive officers, for a further exchange of views.

All of the arrangements for the December 21 meeting are being handled by NASA's Industry Assistance Officer, Mr. John K. Koepf. It would be appreciated if you would let Mr. Koepf know who will be representing your company. He may be contacted by telephone on Area Code 202, Dudley 2–8236.

Sincerely yours,

JAMES E. WEBB, *Administrator.*

Senator HART. Our next witness is Dr. Ralph Miller who is an economist. We welcome you.

STATEMENT OF RALPH E. MILLER, ECONOMIST, WASHINGTON, D.C.

Mr. MILLER. Thank you, sir.

I'd like to say that it is an honor and a privilege to be before this committee to discuss the structure of the computer industry.

To set the record straight, I'd like to point out that I do not have a doctor's degree, as my prepared statement explains somewhat more fully.

[Mr. Miller's prepared statement appears as exhibit 1 at the end of his oral testimony.]

Mr. MILLER. I am an economist residing in Washington, and my prepared statement shows that my expertise in the computer industry comes, in part, from having begun but not finished a doctoral disserta-

tion on the subject; and from my past association with various cases of private antitrust litigation that have occurred in the industry.

I was also, for almost a year, on the staff of the Department of Justice, assigned to the team that was engaged in preparation for the trial of the IBM case. I want to emphasize that I will not today, for that reason, say anything about the IBM case that is currently in the courts, and I do not intend to use any confidential information that came to me in my work, either with the Justice Department or in some of my other work in the computer industry.

To keep the record straight on the sources of my information, what I actually intend to rely upon in large part is the incomplete dissertation manuscript that I mentioned, and that I believe has been available to the staff of the committee for some time; I believe, in fact, since before I was employed by the Justice Department. That manuscript covers the period through 1969, and I trust that the committee will understand that I am limiting the bulk of my detailed consideration to events that occurred during that period, to insure that there is no question about the sources of my information.

Finally, I'd like to emphasize that the views I present here today are my own personal views, and that they are based on my personal study of and experience with the computer industry. I am not representing my present employer nor any of my past employers or clients or any Federal agency and, of course, my views are not necessarily those of any of these parties.

In the statement I make today, I would like first to comment very briefly on what I see to be the computer industry, and to give you some information that I believe shows the industry to be dominated by IBM. Then I shall try to explain how and why IBM has achieved and is maintaining that dominant position. Next I shall turn to the question of whether a more competitive structure for the industry is likely to be in the public interest. My conclusion, of course, is that it is. And then I present and discuss several possible ways that the needed restructuring of the industry might be achieved. The last thing I will say is a comment about the relevance of this analysis, despite its being somewhat out of date in an industry that is changing as rapidly as the computer industry is changing.

My concept of the computer industry—for the purpose that we have before us today—is that the industry encompasses the production and the initial marketing of general purpose electronic digital computers and/or computer systems.

By computer systems, I mean the integrated combination of the hardware—or the machinery—the programs—the software, that is—and the supporting services that are essential to users' understanding of how to make the hardware and the software together do effective work for them.

This definition of the industry that I am using today excludes those firms that are so-called software houses which are in the business of writing computer programs, but do not manufacture or sell equipment. It excludes leasing companies, service bureaus, other entities that purchase computers from the computer manufacturers and then resell them—breaking bulk in a way.

These firms buy computers, and then they lease either the computer services for a period of years, or the use of the computers for an hour

at a time, or what-have-you. The definition also excludes companies that are in the business of making primarily communications equipment or communications systems that may, incidentally, have computing equipment as parts of them. It excludes the manufacture and marketing of military and other kinds of special purpose computing equipment.

I make these comments not because I think that the definition of the industry is a major issue that we should be concerned with, but simply to inform the committee of the subject matter that I am talking about when I comment on what I see to be the computer industry.

Briefly, I now comment about the importance of the computer industry as it's defined in this perhaps somewhat narrow way. The computer industry still accounts for approximately 1 percent of all manufacturing activity in the United States, using the so-called value-added measure which is generally accepted as the best way of measuring the relative importance of industries in terms of the quantity of productive activity occurring in them. That, in itself, is a large amount of economic activity, but I think it is an underestimate of what the computer industry means to the U.S. economy and indeed to the United States.

Mr. Chumbris. Mr. Miller, would you take a question at this point. On table No. 1 of your prepared statement, you show that in 1958, four-tenths of 1 percent of value added is in manufacturing.

Mr. Miller. Excuse me. Is that 0.3 percent?

Mr. Chumbris. Yes. And in 1963, it was 0.7 percent. So there was a gain there over other manufacturers. Is that right?

Mr. Miller. Right.

Mr. Chumbris. Then from 1963 to 1967, it remained steady. So it moved exactly with the rest of the manufacturers.

Mr. Miller. Yes.

Mr. Chumbris. Is there any point that would be important to us: Why from 1963 to 1967 it stayed even; then from 1967 to 1972 it jumped another three-tenths of 1 percent?

Mr. Miller. I think actually—I'm not positive, but my recollection is—that between 1963 and 1967 the Standard Industrial Classification Manual was changed; and the definition of the four-digit industry, which is the way the Bureau of the Census collects this information and compiles it on value-added was changed so that accounting machines and cash registers and other nonelectronic equipment were removed from the industry that included also computer manufacturing. And I believe that if that is correct, that change in the definition of the industry would account for some of the reasons why there was apparently no increase.

Certainly these numbers do not give you a very detailed or careful explanation of the growth of the computer industry and of the output of computers because the four-digit industry, which is the level on which these statistics are calculated, is somewhat too gross to give you a careful measure of what is going on. I presented them merely to give you a rough idea of the facts on the computer industry.

I believe I was commenting about the importance of the computers; not because of the economic activity involved in the manufacture of them or of the distribution marketing, and what-have-you, but because of the way they are used. They are one of the products that

are used pervasively in business and in Government in this country. They are used in practically all industries.

And they are used in those, I think, most important functions of business and Government nowadays, which is the making of decisions and keeping of records.

That seems to be what our society is about, and I think it is a very serious point. We think of businesses as making products, but what really makes our society progress is the decisions that are made in businesses and in Government. Computers are so intimately associated with these processes that they are extremely important to the way the country works.

The next point is that, as I see it, IBM dominates the computer industry. The principal point about dominance is that IBM is the producer and seller of substantially more than half of the value of computer systems produced and sold in this country. That is essentially what I mean by dominance.

The best single way I know of for measuring the shares in the market for computers is by looking at the total outstanding stock of general purpose computer systems. Another word for that total outstanding stock of computer systems is the installed base of equipment. We look at the figures to see who manufactured what parts of it and we calculate market shares on that basis.

Those figures are shown in my table 2 of the prepared statement. The point I would make briefly is that the data in this table indicate with very few exceptions a market share of about 70 percent for IBM, with the remaining 30 percent fragmented. I think the exceptions are the early years of the industry, and the company is Univac; no other company has even had a 10-percent share in the market—that is, in the stock of installed computer systems.

I do not really think it pays to try to look at the detailed figures in this table: to look at 1 percent here or 1 percent there. These numbers are compiled from publicly available estimates about how many computers of the different makes or models are in use and what the prices are for this equipment. I am certainly not preapred to say that those numbers are very accurate. On the other hand I would be surprised if, when these published figures show that IBM's share is estimated at 70 percent, the real or the true value based on the same concept is in the neighborhood of 30 percent. The numbers are not that bad. They are ballpark figures; and the point is that the ballpark is all we really need for the purpose of this inquiry. I do not think it would make much difference to our understanding of why IBM is dominant or what the implications are or what we might like to do about it if IBM's share is 55 percent, or 60 percent, or 70, or 80 percent, or in that range

If IBM's share was 99 I think we would want to modify our understanding of what it is that makes a share that high. If it were that high we might have to have second thoughts about how the industry should be structured. But again, I do not think it is anywhere in that neighborhood either.

Mr. Chumbris. Mr. Miller, if I may interject, we have had some charts, and some other charts have already been submitted. Your statistics seem to be higher than what we have been getting.

I think most of them have around 64 percent as IBM's share of the market. Would that make a difference? You said whether it's 60, 65, or 75 percent, it doesn't make any difference.

But why is it that you arrive at the figures that you have and the others that have been submitted are closer to between 60 and 65 percent?

Mr. MILLER. Let me tell you how I arrived at the figures I have before I explain why they might be different from others.

The publication "Computers and Automation," I think for the early part of this period; and later the publication called "EDP Industry and Market Report," publishes what they call a computer census, which shows the number of computers of various different models installed in the United States and the average price of those computers.

I have used those figures. I have multiplied the number installed by the price. Say that the figures are that there are 100 IBM 360/50's installed and the average price is $40,000. I would take $40,000 times 100, which is $4 million; and do the same for all the other models. Then I add the figures up and calculate the shares on that basis.

As I say, different industry trade publications publish different censuses that will show different figures. I believe, in thumbing through Dr. Brock's testimony, that he was using figures that were compiled in the *Honeywell* v. *Specry Rand* case on which I worked for some time.

I had not realized that those figures were now available in the public record. Those were obtained, I believe, by subpena of data from the computer manufacturers; certainly, one would presume that they more accurately represent the situation than trade press estimates of what is going on. The trade press simply miscounted. They mail out questionnaires. The answers they get back may not always be correct.

Mr. CHUMBRIS. A little later other economists will be having some questions. The reason I was interested in your chart is because a few days ago I raised the question of back in 1956, I believe, one of the charts, IBM had 42.8 percent of the world market and Univac had 51.2 percent of the world market.

IBM had about 47 percent of the domestic market, and Univac had 45 percent of the domestic market.

That was in 1956. And then they also gave the figures for 1974 which showed IBM went up from 42 to 64 percent.

Univac went way down to 8 percent. I asked that the forthcoming witnesses, or in the future, we ought to have a year-by-year chart showing just what caused IBM to jump from 42 to 64, 65 percent, and Univac to go the other way. What caused the other companies who are competitors to maintain whatever percentage they had.

That's why I was interested in your year-by-year statistics. I wanted you to be able to show that from your point of view they could tell one story, and if somebody else has a different type of statistics, there may be reasons for it.

That's why I asked you that particular question.

Mr. MILLER. One comment I would make: In my prepared statement I do discuss the early history of the computer industry.

Mr. CHUMBRIS. Yes; I read your paper.

Mr. MILLER. In regard to that point: In 1955, maybe even early in 1956, the market was divided approximately half and half by Univac,

and IBM. If your figures refer perhaps to early 1956 or if these figures I present are wrong because they were an early registration of a trend that did not come until later, one would find approximately even division between IBM and Univac, I believe.

The only point I would make is that very soon after 1956—if not already in 1956—IBM's market share got up to somewhere in the neighborhood of 70 percent, or well over half. Univac's had fallen to substantially less than half, and it has been tailing off slightly since then.

Mr. CHUMBRIS. Thank you very much.

Mr. MILLER. The question that I think is somewhat more interesting than whether IBM dominates the industry, is the question of why IBM dominates the industry. What factors are there that can explain the acquisition and maintenance of this substantial position in an important industry?

I identify four types of factors that may be important. First, the advantages of large size. We often call all such advantages economies, but the fact is that a competitor that is much larger than its rivals may either be able to produce products at a lower cost, or sell them at higher prices, or possess other advantages.

Second, forces that tend to stabilize market shares and keep them where they are. You note that those forces are somewhat in conflict with advantages of large size. Advantages of large size will help a firm with 40 percent of the market expand to 70 percent, while pushing its rival down, if it starts out ahead. Stabilizing forces simply stabilize whatever pattern of market shares one gets into.

The third group of factors is IBM's special historical advantages: The things that one looks at if one looks at the historical record and discovers that the companies in the industry did not all start out from the same place at the same time.

The fourth group of factors is conduct factors. These are factors that are generally adduced in explaining about industry behavior. I will not say much about them, but I simply observed that conduct is one of the things that explains dominance in some industries.

On the advantages of large size, the first and in many ways the most important are what we call economies of scale, because those are advantages that enable a large company to produce its products at lower cost than smaller companies. Since one of the purposes of competition is to create efficiency, economies of scale might be said to be factors that make large companies more efficient in a useful social sense than small ones.

Economies of scale in the computer industry might arise in several places. In the design and the development of computers, the fact that there are one-time costs involved in doing research, and so on. My own impressions, based on discussions with the industry and a look at the facts I have seen, are that the cost of design, development, and research do create some economies of large scale, but not enormous economies of large scale. It is clearly better to have a large volume to spread fixed costs over than a small volume. But that is not a principal factor explaining IBM's dominance.

On the question of production of computers—including also the production of components—the evidence is mixed, or perhaps the facts have been mixed. Early in the history of the computer industry, I do not think there were very large economies of scale in computer produc-

tion. I think, in the mid-1960's there is some evidence that the technologies developed then were amenable to economies of large scale. I really do not know much about the technology currently in use. I am told, however, by some persons I have spoken to, that they do not think there are large economies of scale. I am told by others they do think there are large economies of scale. I really would not offer myself as an expert on the economies of scale in present production technology.

Another area where there might be economies of scale is in the production of the so-called systems software. Central processors are so fast that these programs are needed merely to make the computers operate effectively and use their time effectively. My own opinion—and it is one that I know is not shared by everyone in the industry, although I think some people would agree—is that there really are no necessary economies of large scale in systems software.

My own impression of the way software is written is that you have a small army of programers writing software, if you happen to be a large company, and then discover by Parkinson's law and because of the difficulties of communication with each other that they manage to occupy all their time doing it. And the writing of software is thus a very expensive proposition. I think the facts of the computer industry will show that the small companies—they are almost an order of magnitude—or a factor of 10—smaller than IBM—manage to get their systems software written. Either systems software is not very expensive to them or to IBM; or if it is expensive, the small companies manage to write their systems software for a lot less than IBM must be spending on it, because they simply cannot afford to spend the same absolute number of dollars as, say, 5 or 10 percent of IBM's revenues that IBM might spend on systems software. They would have no money left over for anything else.

Marketing, and distribution advantages, I think, are more important advantages of large scale. IBM's ability to cover the market, distribute computers from a large number of points, and provide maintenance service locally in many places, I think, does give them an advantage.

Another area where I think there are advantages of large scale is in what I call "external economies of large size." Alfred Marshall pointed out that some economies of scale have to do with the size of the firm, others have to do with the size of the industry. And there are some economies in the computer industry having to do with the buying and selling of excess computer time, markets for programers, exchanging computer programs, and so on.

The only difference between the computer industry and Marshall's external economies of scale is that because of product differentiation in the computer industry these external economies depend not only on the total size of the industry, but on the number of computers of a particular make or a particular brand; because only computers of the same brand are compatible, and these external economies can be shared only by firms that are using computers of the same kind. For that reason any firm that is large has put its customers in the position where they can benefit by sharing with each other these external economies from having a popular computer system. A firm that is small can't achieve those advantages.

The final area where I see advantages of large scale is in product differentiation and market integration. It is an advantage that IBM

has a very complete product line both in hardware and software and in service, and that they are able to assemble a package that caters to practically anyone's needs.

You do not even have to know what you want. You simply have to know that you have a problem, and IBM has a solution for it.

Most companies do not have such large packages. They are not, in that sense, able to compete as effectively in the marketplace.

Stabilizing forces in the computer industry are next. I think the principal one is the enormous product differentiation—the fact that not all computers are like each other.

And as a result there is an enormous amount of brand loyalty in the computer industry. I think a better way of describing that, instead of saying brand loyalty, is to say that the customers are captives of the suppliers.

If a firm has Burroughs equipment installed, it has programs that are written and will run only on Burroughs equipment, because high-level languages are not always used in all computer systems or because perfect compatibility is not achieved even in all higher level languages. There is, therefore, an enormous cost of converting a computer installation from one manufacturer's system to another manufacturer's system. When one manufacturer brings out a new product line he tries to arrange conversion for his own customers, but it is much more difficult to convert between manufacturers.

IBM's special advantages are the third group of reasons that explain its position in the computer industry, and these are primarily historical.

IBM was the dominant firm in the old tabulating equipment industry, which was the predecessor of the computer industry, up through the mid-1950's. It had the sales force. It knew the customers for information processing equipment. It knew what kinds of work businesses wanted to do. It had a large lease base of tabulating equipment and a cash flow from it. It used tabulating equipment as input and output devices for its computer systems. And thus, by having the front end—the input and output arrangements already installed in these businesses—IBM, in effect, was able to tie its computers in a package with them.

It is also said that Univac, which was IBM's chief competitor in the computer industry at that time and its only substantial competitor in the tabulating equipment business, was not well managed at that period.

The final group of advantages that IBM may have is its conduct in the marketplace. And as I said, I do not wish to comment any further about conduct, but simply to note the possibility that conduct exists. My reason is primarily a feeling that this is a matter that is likely to be important in the litigation and, since the concern with this committee is whether there is competition and whether structural reorganization is appropriate, I think that it is reasonable for me to avoid the question of conduct here.

To sum up the question of these forces that account for all of IBM's dominance, my own view is that the rise of IBM to dominance in the computer industry is due to a combination of historical circumstances; namely, IBM's dominant position in the tabulating industry and its good management at that time, particularly relative to its competitors.

I do not think that IBM's initial rise to dominance was due in any significant way to advantages of large scale.

I think IBM's continued position of dominance is due primarily to what I have called the stabilizing factors—brand loyalty and things like that—with perhaps considerable assistance from a pattern of conduct that may have reinforced those structural features that do tend to stabilize market shares. I think there are some advantages of large scale, as I have said. But I do not think those have had a major impact on IBM's share of the market, because I think that what they really explain was how IBM was able to charge prices high enough to earn very considerable excess profits without having that market share degraded.

If there had been no advantage of large scale then IBM would perhaps have been forced to choose between earning excess profits and seeing its market share competed away—as is said to have happened to U.S. Steel in the early part of this century—or maintaining its market share but not being able to earn excess profits.

I think, now coming to the questions that are crucial to what I understand to be the purpose of these hearings, that the committee is interested in knowing whether a more competitive structure for the computer industry would be in the public interest, because that, I understand, is the kind of question that is raised by the Industrial Reorganization Act.

The general proposition in favor of structural change is that more firms are better than few, and that competition is more effective if the large firms are smaller rather than if they are larger. This committee has heard from numerous experts on this proposition who are much better qualified than I am to offer opinions and views on it, and I cannot see myself trying to repeat that record. I will, therefore, confine my comments about reorganization of the computer industry to facts peculiar to the computer industry, or facts that are relevant, primarily, in the computer industry.

First, of course, there are monopoly profits in the computer industry over the long period of history. IBM's rate of return on the shareholders' equity—that is, the net income after taxes as a percentage of the equity—has been in the 15- to 20-percent range for at least the last two decades, and indeed in the upper part of that range for most of the period.

That is a higher rate of return than is needed to attract capital for investment in the business. It is higher than the average rate of return on all manufacturing; and my own opinion is that the average for all manufacturing includes already a substantial chunk of monopoly profit in it.

If we look instead at profits before taxes in relation to revenues, we see that over a long period of years approximately $1 of every $4 that IBM receives in revenues is profits before taxes. Of course, something like half of that profit is picked up by the Government—mostly the Federal Government—in the form of income taxes. But we still see that most of what you are buying—not most but a quarter of what you are buying when you buy an IBM computer—is profits to the shareholders or taxes on profits to the shareholders.

But to say that there are monopoly profits, and to say that they could be eliminated by reorganizing the industry, is not to say that reorganization is desirable.

If the monopoly exists because IBM is able to produce computers at substantially lower real cost than its competitors—if there are economies of large scale—then increasing competition by eliminating IBM's dominance would merely raise IBM's costs, not lower prices to the public, and at least in regard to monopoly profits I do not see that it would be achieving any major benefits. So one does want to find out where IBM's monopoly profits come from, and how they relate to the factors that make for its dominance.

One possible factor is IBM's ability to sell the same product, but at a higher price than its competitors. The record on that is very unclear. Some statistical work done showed that in the mid-1960's IBM indeed was able to sell its computers at a higher price than competitors could sell equivalent equipment. More recently, other statistical work has not been able to find that relationship. It is very difficult to do it because it is so difficult to measure computer products.

I think the most likely result of structural change in the computer industry—and one that I think is highly desirable—will be an improvement in product performance in the industry. There will be a decrease in product differentiation, and perhaps a decrease in marketing activity and in the kinds of support that are provided by the computer makers to the users. I think that there will be greater modularity in computer parts, that different kinds of hardware will be more compatible with each other so it will not be necessary to buy complete computer systems all from the same manufacturer in order to get things that will work together.

I think the expertise in putting computer systems together will still be needed, but it will be transferred or it will move from the computer manufacturers, where it is part of their marketing effort, to the users of computers who will be in a position, perhaps with expert advice again from a reasonably competitive industry of data processing experts to put together complete computer systems from the offerings of a variety of different manufacturers—some of whom produce a relatively long product line, others of whom are specialists in products where they have particular expertise.

I think this kind of structural change will also lead to improved technological performance with firms focusing on the development of improved "components" rather than improved systems. This is very much like the debate that has gone on, particularly in connection with weapons systems development—not computer parts, but simply weapons systems in general—whether one should be working on components or systems. I am one of those who believes on the basis of a very imperfect record that the components approach is better than a systems approach.

I think also if the users are forced to put their own systems together and learn more about them, they will do a much better job of using their computers. There have been fiascos of computers having been oversold and not performing as they should have. There have been problems of computer fraud that I think have arisen from the fact that managements just do not understand what is going on in the computer shop. They do not understand the way in which it affects their business and, as a result, they are not able to control it. The computer companies, for other reasons, are not interested in controlling on that same level fraud in the use of computers. I think these problems may be dealt with by structural change in the computer industry.

I mentioned a couple of other advantages of structural change in the computer industry in my prepared statement. I think also, though I'd like to go on now in the interests of finishing as quickly as possible, to the question of how structural reorganization of the computer industry might be achieved.

I think the first point, that is fairly obvious but important, is that IBM is the only firm that needs to be reorganized. Even after we allow for the recent changes in the market, with Honeywell and GE having been put in the same box, and with Univac having picked up much of RCA's share, IBM is still at least six or seven times as large as the second largest firm in the industry. These others have market shares under 10 percent. If we could cut IBM into pieces that were no bigger than that the industry would pass the test of having a four-firm concentration ratio under 50 percent as specified in the proposed act.

I think also that if one is reorganizing IBM, one would begin with the obvious point of removing the noncomputer businesses from IBM—its typewriter business, its office products business in general—which, incidentally, is also reputed to be highly profitable—its information records business, the Federal systems division which does mostly special purpose computer work.

The interesting questions come when we start looking at what may be broadly classed as the computer industry, whether we can cut such things as the small information processing systems—like System 3—or the peripheral equipment or what-have-you away from the rest of IBM's computer business. As far as small information systems are concerned, I think we can cut them away. They are organized presently as a separate division from the main computer business of IBM, and I cannot see any reason why they should not be separated.

Peripheral equipment and, later, components are a different problem. On the question of integration within the computer industry, I think that questions like these should be left to the determination of market forces. In this, I shall be disagreeing with some of what you have heard, I believe, this morning and perhaps at other times in the hearing. If the computer industry can be set up with a competitive horizontal structure so that no one firm or no few firms dominate the production and marketing of central processing units, I think that the market is the proper place to determine whether there are or are not important economies in joining with the central processing business such things as peripheral equipment, component software, or what-have-you. If there are economies to be obtained by having the same firm produce all of these things in an integrated fashion, that is what the market solution will be.

If there are no such economies, then independent components manufacturers and independent manufacturers of peripheral equipment will survive and thrive.

My main point is that if the computer industry is broken up so that there is no longer any dominance of the central processing business, there is no longer any need to try to insulate that business from the other aspects of the computer market to prevent the spread of monopoly power. There is nothing to spread. There is no need to go into the question of whether there are or are not economies in these areas.

I think the same comments apply in particular to systems software. I have already said that in regard to other software, I believe that if the computer industry is restructured with substantial horizontal dis-

solution that there will be less product differentiation, in particular in the software area and to some extent in the peripheral areas, and there will be less integration because specialists will turn out to be better than some of the systems companies at making certain kinds of peripheral equipment. The systems companies, being in a competitive market, will be forced to look for good products to complement their central processors and will take advantage of this expertise in other companies, and so on.

As for a dissolution plan, I would say that I believe that dissolution of IBM horizontally is feasible. Even as long ago as 1968 there were some 20 computer manufacturing plants and 13 laboratories in IBM and IBM World Trade combined. Even if one looks at only the domestic market, I believe the horizontal dissolution is feasible. I do not see that it is necessary that all the successors start out on an equal footing. The purpose of this operation is not to be fair to some handful of successors of IBM. The purpose of this structural reorganization is to create a competitive structure for the industry; and if in that competitive structure, it turns out that for reasons of bad management or whatever, one of the successors is not viable, I do not see that as necessarily being a loss to the economy or the public.

Obviously, one does not want to put a lot of assets into an operation that has knowingly been set up so that it cannot survive, because that will cause economic losses. But I do not see concern with viability and fairness as being dominant considerations in the way that perhaps underlies some other views of what is needed in the way of horizontal dissolution.

I think these matters are covered in more detail in the prepared statement. I'd like to close with one appeal on the question of structural reorganization.

In 1956 the Justice Department settled by consent the suit that it had filed in 1952 against IBM, which was concerned primarily with the tabulating industry—the tabulating equipment industry. That settlement did not involve structural reorganization. It did involve other remedies that were presumably, in the opinion of the Department at that time, satisfactory.

I think the historical record, and the mere fact that we are sitting here talking about IBM's dominance in the computer industry, is fairly persuasive evidence that that particular consent decree did not do what it should have done. Maybe it did the job it was intended to do—namely to prevent domination of the tabulating industry—but it did not do the job that in retrospect it should have done; namely, prevent IBM from dominating the computer industry.

And again, if we are concerned with what will happen in the future we should be concerned not with a structural reorganization that will take care of the problems that we are able to understand now as best we can comprehend, but rather a solution that will increase competition and not provide a base for IBM to move into the future with whatever it brings, and somehow transform the advantages it now possesses into something that will enable it to dominate whatever the computer industry will turn into over the next decades.

Thank you for the opportunity to make this statement.

[Mr. Miller's prepared statement appears as exhibit 1 at the end of his oral testimony.]

Senator HART. Thank you very much.

Mr. Nash?

Mr. NASH. Mr. Miller, in your statement, you discuss the possibility of restructuring IBM's facilities. You indicate that if we include IBM's foreign facilities in world trade, we should be able to create a half dozen or so successful companies.

If I understand your statement correctly, you have six or so fully integrated computer systems, each making CPU system software, peripheral equipment application software; is that right?

Mr. MILLER. Certainly in regard to the first three—CPU's peripheral equipment, and system software—they would be fully integrated. Since I do not contemplate any particular provision of the reorganization plan that would prevent them from making applications software. I assume they would be in that business.

On the other hand, I should comment—as I think you said correctly they would be integrated—that it does not mean that the product lines would all necessarily all be as long as IBM's present product line. The new product lines would be as long as is typical of the other firms in the industry. Those are product lines that seem to be long enough for the companies to survive, if not make profits. Indeed, recently, as I see from other testimony—I believe yesterday—some of them are even beginning to earn reasonable rates of return on their relatively short product lines.

Mr. NASH. Given your comments about the inadequacy of the 56 percent, is it your opinion that effective relief or effective restoration of competition through the computer industry requires eventual divestiture?

Mr. MILLER. Yes; but I want to emphasize that I am not talking about effective relief, but simply about the purposes of the Industrial Reorganization Act. I do support the proposition that, quite apart from questions of the antitrust laws as they presently stand, structural reorganization of the computer industry as contemplated by the act is necessary to restore what I consider to be effective competition, in an economic sense, to the industry.

Mr. NASH. Now, accepting such a horizontal divestiture for the moment, let me ask two questions.

In your judgment how would the existing manufacturers fare under such a program; say, for example, Honeywell, CDC, and so on?

Mr. MILLER. I think they would as a group probably fare quite well. I think, of course, that if the computer industry becomes more competitive, then all of the manufacturers, including the ones that are presently small rivals to IBM, will be pushed a little bit further by market forces; and if they are pushed somewhat harder by market forces, some of them may decide to retreat away from the heart of the computer industry and enter more specialized areas; some of them may simply not be able to hack it.

As as group I do not see any problem. I think, on the other hand, that if IBM were cut into a smaller number of pieces than half a dozen—if IBM were cut up, say, into three pieces, which, of course, would not be enough pieces to make the industry qualify as not being a monopoly under the proposed act—it is possible that in the situation the other manufacturers would be worse off than they are competing against the single IBM.

Mr. NASH. But you believe that if six entities were formed the market power would be sufficiently dissipated so that existing companies could effectively compete?

Mr. MILLER. I said about half a dozen. If one wants to press me on whether that really means six as opposed to seven, I think the answer would be that my information is probably a little bit too out of date. You would have to tell me whether IBM's present market share is really 70, 75, or 65 percent at this time, and whether Honeywell and Univac are really 9 and 8 percent, or whether they are not.

Mr. NASH. So, your No. 6 is an order of magnitude?

Mr. MILLER. I think my No. 6 is something like minimum, and I would certainly, from what I know about the industry, say that eight is big enough, as long as they are approximately equal in size.

In other words, eight is certainly big enough; six, I think, is probably good enough.

Mr. NASH. Under such a horizontal divestiture program won't barriers still exist for the independent peripheral manufacturers and software houses?

Mr. MILLER. Unless there is a change—which I said I foresee—in decreased product differentiation and so on, there will, or there might. On the other hand I do not see it as being an important part of the public interest to protect independent peripherals, manufacturers, or independent software houses, or anyone like that. I think it is important to the public interest that the forces of competition pervade the marketplace. If, for reasons of structure or because there are economies, it is more efficient for one company to manufacture CPU's, peripherals, and a good bit of software, I do not have any problem in seeing that kind of integration.

When we talk about the automobile industry no one suggests that a proper way to reorganize the automobile industry is to have some companies manufacture engines while other companies manufacture bodies.

Mr. CHUMBRIS. I have a surprise for you. One witness testified in February that what they ought to do is have one of them make fenders, another make bodies, another do the forging, and so forth.

Mr. MILLER. I stand corrected. It is my understanding that that is not what most people have in mind when they talk about reorganizing the automobile industry.

I think the point is that if we start scratching the surface, we discover that there is integration in many industries. In the computer industry it is a little bit more obvious, because firms have started nibbling away at some of these pieces of the market, or at least trying to nibble away, and we become concerned with them. But as a general proposition I do not think that that kind of integration is something that we should be concerned about, so long as there is competition among the manufacturers of the integrated products.

Now, I would also add my view, as I tried to make clear, that I do not think that integration will persist for decades, or even very many years, if we reorganize the industry, because suddenly the small computer manufacturers will discover that their money is better spent in improving their CPU's and their systems software, and perhaps one or a few peripheral products that they are specialists in. But they will not all decide that they can make tape drives. They will decide

that some company sitting off on the side that is concerned primarily with manufacturing tape drives, or disk packs, or terminals, can do a better job than they can, and that it is in their interest to design their CPU's so that they are complementary with, and compatible with, these peripheral products of other manufacturers.

That is the way successor A of IBM will compete with successor B. Successor A will say, "company X over there in the peripherals business has a better tape drive than either I have or successor B has, and the way in which I can do better than successor B is by designing my CPU's to integrate with that tape drive, somebody else's disk pack, someone else's communications equipment, and that way the user will be able to put together a better system using my product than he will using successor B's product, because successor B persists in trying to put together a much more integrated system than he can really handle."

Mr. NASH. In your proposal for reorganization you also discuss four market areas which are closely related to the computer industry itself.

The first is a small insulation processing system; and I gather you conclude that it is feasible to construct a separate company out of that?

Mr. MILLER. I believe that is what I said, and I stand by the conclusion that is feasible.

Mr. NASH. You do indicate difficulties in separating production from peripheral equipment, electronic components, and software.

Now, with respect to components, you did indicate IBM once had a separate components division and separate plants.

You went on, then, to show technology changes. I was wondering whether the production facilities for components today are still separated?

Mr. MILLER. I do not know whether the production facilities for components today are still separate from those of CPU's. I looked recently at IBM's 1973 and 1972 annual reports. It was from the annual reports of the corporation that I had gotten my previous information about what plants did what; and I no longer find plants being identified as components, or systems, or what-have-you, but simply manufacturing. So, I cannot honestly say that I know the answer to your question.

Mr. NASH. A number of witnesses have keyed in on the components and pointed out, given the changed technology, that the components division is fast becoming a key to market control.

You have indicated we might face a loss of economies if components were divested, if I understand your statement. You didn't feel divestiture of components divisions was that important.

Could you elaborate on your views with respect to components being divested?

Mr. MILLER. My point was that I certainly am not in a position to say that there are substantial economies of integrating components with processes. There may or may not be; I do not really know. I would not want to take the position that nothing would be lost by removing them.

On the other hand, if IBM is broken up horizontally into half a dozen parts, and if four of those half-dozen parts have a components

plant, then we are in a situation where the use of the components manufacuring as a basis for dominating the computer industry is no longer possible.

Now, if it is true that there are very substantial economies of large scale in the manufacture of components for computer equipment, then we have a problem that there may be a structural tendency to monopoly in that particular business. My own observation is that there is a relatively large number of manufacturers of semiconductors—that is, integrated circuitry—that the computer industry is not the only industry that uses integrated circuits; and that there are many independent firms, many of them even very small, that are in the business of manufacturing circuitry. My understanding is that many of the other computer manufacturers besides IBM do not maintain their own components facilities. They somehow manage to produce computers out of components that are manufactured in conjunction with other integrated circuit manufacturing for other purposes. Under those circumstances, I do not see that there would be—that there is likely to be—a major problem in the horizontal breakup of IBM's components business.

As I said, there were four components plants—or, more precisely, there were three in existence and a fourth being constructed—the last time I carefully looked at those facts and saw them published by IBM. With that breakup, I think it would dissipate any likely monopoly power that presently is in the components operation of IBM.

Mr. NASH. Thank you very much.

Senator HART. Mr. Chumbris?

Mr. CHUMBRIS. Thank you, Mr. Chairman. I have had my questions. I will turn it over to Dr. Granfield.

Mr. GRANFIELD. Thank you.

I hope to ask a set of interrelated questions which, to me as an economist, are consistent and form a particular pattern. I hope I can convey this to the witness and, more important, to the record.

First of all, Mr. Miller, have you had an opportunity to read volume 1 of the hearings of the subcommittee concerning the Industrial Reorganization Act?

Mr. MILLER. I have not read all of it. I have looked at parts of it.

Mr. GRANFIELD. Then you must be aware of the fact that, somewhat contrary to your statement, there is tremendous controversy about the question of whether industry structure tells us anything about the level of competition within the industry.

Mr. MILLER. I am aware that there is considerable controversy about that point; yes, sir.

Mr. GRANFIELD. Specifically, some economists wish to direct examine the proposition and have it in a structural hypothesis, that when you have an industry dominated by four, or six, or eight firms, depending upon whatever concentration measure you are using, this indeed enhances the possibility of tacit collusion, such as firms together simply restricting output and therefore having a highly competitive price. Are you aware of this controversy?

Mr. MILLER. Yes; I am aware of it.

Mr. GRANFIELD. In order to balance out the statement that there are some who believe that the structural approach to explain economic conduct and performance is valid, others cast doubt on this present evidence to support their contrary position; is that not correct?

Mr. MILLER. What you are suggesting is that there is dispute over the question whether dominance of an industry by a single large firm—and let me not say "dominance," since that is what you are challenging—there is a dispute over the question that the possession of a large market share by a single firm means the industry is not competitive. You are asking me whether that is the case; whether there is dispute over that proposition?

Mr. GRANFIELD. On the contrary. The structure has not dealt with the problem of an industry dominated by a large firm.

I think if you examine your own footnotes, Professor Baine did not include any industry dominated by a large firm in his surveys, nor has Professor Casson or Professor Turner, or the former chief economist of this subcommittee, Mr. Blair.

There is no such industry in the computer industry that is not contained in any of the analyses.

Mr. MILLER. I am certainly not going to dispute that statement. I think it is probably right. If it is, it would not surprise me if the reason is that no other industry has been dominated by a single large firm in the way that the computer industry has been.

I am not sure that is the case, but it is my impression that probably since 1911 there has not been an industry like the computer industry that one could have included in studies of that sort.

Mr. GRANFIELD. Well, let me add that structural hypothesis does not yield to the question this committee addresses itself to: Specifically, the level of competition in an industry dominated by one large firm. It is a separate question from that which the structurals are directing themselves to.

Mr. MILLER. My own answer—and it may not be a good one—is the belief that there is some sort of continuity. And if what you are saying is that the structuralist—if you are characterizing the structuralist hypothesis as applying only to what happens when the number of large firms is few—hypothesis is applying when there are two or three firms dominating an industry and saying, "Well, but if there is only one, the situation is different," my reply is that I, at least, am a believer in continuity, and the whole theory of the structuralist hypothesis is that one large firm is even better able to do, by virtue of being one, than what two or three large firms would. So, at least, I think that the structuralist hypothesis does purport to cover the situation of the computer industry, or is properly extended to cover the situation of the computer industry.

The structural hypothesis itself may not be correct. I am willing to grant that there is dispute about the correctness of it in the first place. But I do think it at least covers the computer industry.

Mr. GRANFIELD. What the industries want to show with the four, or six, or eight firms, is, one, that they relatively earn similar rates of return. These rates of return are above the normal rate of return, and this is their evidence that collusion is in fact current.

If we look at the computer industry it is in direct contrast to the structuralist approach, because we have one firm allegedly earning higher than normal profits, and many other firms not earning normal profits.

And to include an industry such as the computer industry and more of these kind of industries—this kind of distribution that you find—

the more you will refute the structuralist hypothesis, because it is directly based on statistical findings of homogeneity or returns among the leading firms of the industry.

Mr. MILLER. My answer to that question is that there is homogeneity of rates of return among the leading firms in the computer industry. IBM's rate of return is the same as IBM's rate of return. There is only one leading firm in the computer industry that qualifies in the antecedent part of the structural hypothesis and, obviously its rate of return is homogeneous with itself.

And I would also point out that it has been remarkably stable over time.

Mr. GRANFIELD. It says nothing about the key element in structural hypothesis data of successful tacit collusion, unless you were going to say IBM is colluding with itself.

Mr. MILLER. I am certainly going to comment that IBM has at various times been organized in division structures that encompass different parts of the marketing in the computer industry, or the production and marketing, and that is indeed the point. The structuralist hypothesis has to do with the setting of price policies in relation to cost. And again I would say that the pricing policy of IBM can be presumed—I certainly have no evidence—but I would presume that the pricing policy of IBM is coordinated with itself, which again is the natural extension, on a continuity basis, of the structuralist hypothesis about what happens in structurally concentrated industries.

Mr. GRANFIELD. At least, then, when that is true, when you break out, then, a long division which you suggest, they will then simply tacitly collude among each other and produce the same result as we have today; if that is true.

Mr. MILLER. That had to do with my point that three successors to the IBM computer business is not enough; six would be, at least as I understand the measurements of IBM's market share. Three successors would leave a four-firm concentration ratio of approximately 80 percent, if IBM has 70 and if the next largest firm now has 10, since the top four would be the three successors plus the next largest; while six successors to IBM, if they are equal in size, would bring the four-firm concentration ratio down to the low 40-percent level.

I make that comment primarily because I believe that the Industrial Reorganization Act sets a four-firm concentration ratio at 50 percent—correct me if I am wrong—which is the level at which monopoly is presumed; and breaking IBM into six pieces will bring the industry not very far under that line, but clearly under that line on the basis of the figures that I have available to me as to its market shares.

Mr. Nash asked me whether I thought six was enough, and I said I thought six was enough. Maybe I am wrong; maybe it is eight. The structuralist hypothesis does not say that tacit collusion will occur no matter how many firms there are in the industry. It says it will occur if there is a relatively small number of relatively large firms who together account for most of the output. I am simply offering a judgment that in connection both with the standards in the proposed act on which we are having the hearings, and in connection also with such of the economic evidence that I have seen, it would appear that six successors to IBM would break the industry into enough pieces, of which none was particularly large, to lead to reasonably effective competition.

Mr. GRANFIELD. Do you know of any economic evidence that says when we go from 8 percent concentration ratio to 40, the competition suddenly ensues?

They show that the price-cost margin goes to zero when that happens?

Mr. MILLER. I certainly do not know of any evidence that the price-cost margin goes to zero. I have stated before, I believe, in my oral testimony and certainly in my written testimony, that I am not setting myself up as an expert on the general questions of industry structure and performance throughout the economy; that the record on this question, as you yourself pointed out, has been made before this committee by a variety of experts who are much better able to respond to your question than I am.

I do not even think it is necessary or appropriate, in view of my own qualifications, for me to try to answer that question for the record of this committee, since it has been done better on both sides by persons who preceded me.

Mr. GRANFIELD. The only reason I bring this up is that if you propose to restructure an industry, one should present evidence himself, or at least have a firm grasp of the issues involved that the general structure approaches, because that is the entire purpose of the argument; that the structural approach is the valid way to measure competition.

Mr. MILLER. Let me say you are correct, that the reliance on the hypothesis of the structural approach is certainly a major element in my conclusion about the merits of reorganizing the industry. I clearly do want the record to show that. And, let me simply say that I am not prepared today to discuss or defend the merits of that proposition beyond the few references I have in one of my footnotes; but if you wish, I would, given the appropriate time to prepare, be happy to come back again and discuss that matter with you.

Mr. GRANFIELD. Would you agree with my comment that if economists with improved sources of data—assuming it was done in a competent, judicious manner—that if the structural approach was tested and found lacking this would cast a grave doubt on your whole approach to the IBM situation?

Mr. MILLER. I do not know that it should cast grave doubt. It should certainly cast some doubt on my approach to the IMB situation. I have in my prepared statement at least, made comments about some of the other problems that are not so directly related to the question of market competition in a narrow sense; about the problems of having a single corporation being responsible for the production and, in many cases; the integration with the business operations of the information handling systems for so many large companies; and about the impact of large corporations on the way in which government and others react to the situation. All of these, I believe, are problems that structural reorganization of the computer industry would go a long way toward resolving.

I believe, also, that my study of the computer industry, imperfect as it is, adduces some evidence that tends to support the structural hypothesis, at least as it applies to the computer industry, and that is the main reason I say that if you did find the structural hypothesis wanting, that would cast some doubt on my conclusions about, or my

analysis of the computer industry; but it would not be such grave doubt.

It might be that the structural hypothesis is not generally applicable, but that the same situation or the extension of it to the single firm dominance situation does provide a good explanation of what is going on in the computer industry.

Mr. GRANFIELD. What do you mean by effective competition?

Mr. MILLER. It is a very difficult term to define. A simple definition of it is that effective competition is the situation in which the behavior of the individual firms is subject to the discipline of the market and of market forces; that firms do not have the discretion to decide what prices they should charge or what kinds of products they produce, other than the question of going into or getting out of the industry: that they are not in the position to manufacture inferior products, not necessarily deliberately, but that they simply cannot survive by manufacturing inferior products.

It is the old question of the small grocery store and the supermarket business, that Mr. Sam moves out and larger units go into the food retailing business because firms are subject to the discipline of market forces.

I think that is the best simple definition of effective competition.

Mr. GRANFIELD. Don't you think that the exit of RCA and GE from this industry indicates they, themselves, admit they could not have the competitive pressures and this industry looks at that kind of effort to be extremely competitive. That was the same as the "Mom and Pop" store.

Mr. MILLER. The question is not whether RCA and GE are subject to competitive pressures, but whether the bulk of the industry, that 70 percent or so that IBM has, is subject to competitive pressures. I hardly think one can call an industry competitive by saying that the firms that dominate it and are not subject to competitive pressure make the kitchen so hot that everybody else has to get out.

Mr. GRANFIELD. My recollection of the dominant model in economics indicates what happens is the dominant firm sets a price which maximizes his profits.

The other firms in the industry are forced to take the price set by the pricer and they are earning a normal rate of return whereas the dominant firm earns economic rents, but we don't see exit in that industry.

That doesn't seem to be what happened here. It happens to be characterized more by a continued, vigorous competition.

Do you have any comment on that?

Mr. MILLER. I find the premise in your question somewhat contradictory from your previous one. You correct me if I am wrong, but I believe what you said is that we do not see exit from the computer industry.

Maybe if you repeat your question, I will better understand how it relates to the one before.

Mr. GRANFIELD. Certainly. I said I did see exit in the computer industry which seems to run contrary to the—at least, the textbook model of a firm, of an industry dominated by a leading firm, which he makes his output and his pricing decisions in order to maximize his profits, the other firms in the industry are forced to be price takers

and they earn a normal rate of return and under these conditions you normally do not see exit.

Mr. MILLER. Let me first say that I am not sure I agree with the premise about the textbook model. If in the textbook model the dominant firm decides to lower its price a little bit below the short run monopoly profit level, it can be presumed to expand its market share at the expense of its rivals. But to go to the facts of the computer industry, I don't really think that the dominant firm textbook model you gave insists that there be no entry into or exit from this industry. The model simply suggests a stable market structure, and in a broad sense that is what I think I see in the computer industry.

IBM's market share has, according to the best figures publicly available that I have seen, been approximately stable. There has been exit but there has been also, in that sense, entry or growth of other firms. There has been, if you wish, turnover in the non-IBM part of the computer industry; and I think that is a natural occurrence when you take into account the fact that some of the other smaller firms may not be as well managed as some of the better managed among IBM's smaller rivals, and they tend to lose market share to the better managed ones. We see that sort of turnover, so I do think that is consistent with the textbook model that you described.

Mr. GRANFIELD. In a December 1972 American Economic Review article by Professor Belchen, in attempting to explain differential rate of returns, the hypothesis was that there is no single segment of a firm with superior performance.

It's a team aspect of the organization that leads to the earning of economic rents. Is it not possible that, although we separate out and examine intensively any one of the IBM divisions, they appear to be not inordinately superior to competition, but it is the unique combination and information flows that IBM manages through this complex organization that leads to their superior performance.

Is that not a possible hypothesis?

Mr. MILLER. I will certainly grant it is possible, but before I comment, I'd rather hear what the next question will be.

Mr. GRANFIELD. If this is indeed true, is it not possible that we will lose this tremendous team efficiency if we operate IBM in the manner you suggest?

Mr. MILLER. I am somewhat hard put to answer that question because there may be some confusion about what we are talking of.

Are you suggesting that the loss will come about because we separate the Office Products Division from the computer business or is it something else?

Mr. GRANFIELD. That is correct.

Mr. MILLER. If we are thinking of IBM as a conglomerate, a company operating in a number of industries, and if what you are suggesting is that the efficiency of the operations has to do with the fact that the management is very good, I am certainly not familiar with any substantial body of economic evidence to suggest the fact that either the efficiencies of a large conglomerate corporation are dependent on its being a conglomerate, nor am I familiar with any evidence to suggest that the quality of management is destroyed by putting it into smaller pieces.

There is another way of responding to that problem. I certainly am not disputing that there is something about IBM that allows it to

earn substantial excess profits; and I also accept and indeed vigorously espouse the proposition that one of the benefits that will result from structural change in the computer industry will be the creation of the situation in which those monopoly profits will no longer be earned by IBM. Thus, if what you are asking me is whether I think the reorganization of IBM will cause a change in the situation that creates this problem, the answer is, yes, of course, that is one of the purposes of a reorganization: to do something to deprive that collection that we call IBM, whether it is management information flows or anything else, of the ability to so control its destiny that, among other things, it is able to charge prices so far above the cost of its doing business that it earns substantial monopoly profits.

Mr. GRANFIELD. Well, this is exactly the point I wish to bring out. It's whether these are monopoly profits or are they economic rents? Economic rents is superior management, and if we break it up IBM loses the economic rents, and the market loses that efficiency to the detriment of the consumer of those profits.

To quote from your testimony, you indicate that one of the efficiencies or one of the talents of IBM when they first encountered Sperry Rand was they learned a great deal about managing customer services in the computer business; and although it didn't look like selling typewriters would lead to a better computer division, in fact, that seems to be a transfer of ability.

I don't know how it would be inhibited. This kind of efficiency ultimately led to better customer service, that it would be lost as it would be in many firms if you attempt to divest it along the lines you suggest.

Mr. MILLER. I would comment primarily about the facts. What IBM transferred was not expertise in selling typewriters. I do not know even how important IBM was in the typewriter business in the early 1950's. What IBM transferred was its expertise in selling tabulating equipment, punched card equipment, into the successor of the punched card equipment business; namely, the computer industry.

The point I would now make is not that expertise in selling tabulating equipment is important to the sale of computers and therefore, should be preserved. I think the important point to make is that IBM dominated the tabulating equipment business to a much greater extent, even. than—at least, according to what little evidence there is on that point—it dominates the computer industry. One way in which I might characterize your argument—it is not entirely fair but it may be a beginning point for exchanging views—is that you seem to be suggesting that because IBM dominated the tabulating industry and was able to dominate the tabulating industry, whether that was good or bad for the economy at the time, it is important that we allow IBM to transfer that monopoly to the computer industry, because there is some efficiency in letting computers grow out of tabulating equipment; and because IBM dominates the computer industry we ought to let that dominance go on forever, including all the other industries that may eventually grow out of the computer industry, because we are going to wrench the system somehow if we ever try to do something about it. I will not buy that.

Mr. GRANFIELD. If you force IBM to divest itself along the lines that you suggest, however, all of the benefits would be lost. This was in previous testimony.

Mr. MILLER. The response I would make is that in my analysis of the industry I have tried to identify specific areas where I think IBM's advantages lie. I have tried to distinguish between those that involve what I call true savings of resources, or true social cost savings, and those that are really private pecuniary advantages that have nothing to do with benefits to the public but simply give IBM advantage over its rivals in the computer industry. I have found, by my analysis, that most of the explanation of IBM's dominance lies in that latter group of advantages.

You are now proposing sort of an agnostic view of things, at least as I see it; namely, that one possibility is that somehow by some not carefully documentable process, some kind of synergistic process of combining all of these things in one group, we somehow achieve an entity that in unspecified ways is more efficient than smaller entities, than IBM's smaller rivals. And you are suggesting that we will lose whatever these benefits are, these things that come about in unspecified ways, if we break up IBM.

Without a more precise description from the proponents of that view as applied particularly to the computer industry, of exactly what economies result from this combination, I am totally unable to respond.

Even if I had a more detailed description I would add that when it comes down to detailed facts about this or that economy in the computer industry, or exactly what the situation is, my experience, while it stretches over a period of years, is limited essentially to the interaction with personnel of two companies plus what I can glean from having read the trade literature in a period that ended some 5 years ago, because I have not done work on the industry since then except in connection with the Justice Department suit in which I was involved, and which I cannot bring to bear at all on what I say today. Therefore, I can only repeat that my analytical finding that these advantages are resident somewhere else.

Mr. GRANFIELD. Well, my only point—and I certainly don't wish to belabor or bore you with it—is that there are two ways economists explain an industry dominated by a single firm: One is as alleged in numerous antitrust suits against IBM, that it is doing something illegal to preserve its rate of return. The other view is that IBM simply is a superior performer. The source of that superior performance is not necessarily easily separable out into what the economists either look at as production economies of scale, or marketing economies of scale, or distribution economies.

They may all also be present. But the most significant source of efficiency for that superior performance simply may be the organizational structure and the dynaminism of that organization.

For example, I would argue that if you examine the relevant corporate structures of Sears and Montgomery Ward, their buying practices and so forth, you would find remarkable similarities; that year after year Sears outperforms Montgomery Ward.

Some allege that simply because of superior management capability of the Sears executives, and Sears spends a great deal more money and time training their executives, this is where the rate of return accrues to Sears, this team group of managers; and that IBM tradition has been to spend more in the trade and promotion of the human capital.

At least that is an alternative hypothesis to explain superior performance not only of IBM but of any firm in a particular industry that

far outperforms its competitors. And the resolution of that ultimately, in terms of economics, is that if it is not found that the firm has constructed artificial barriers that, indeed its performance is explained by superior organizational efficiency; and that is a subject that as a problem has not yet been resolved.

That is the only thing I wanted to bring out. There are two alternative hypotheses here. We do not have any resemblance of sufficient evidence to make a decision as to which hypothesis is correct.

I would submit that both are equally valid hypotheses to explain superior performance.

Mr. MILLER. That has been a long question. There are a couple of points that I would like to respond to: One, primarily to keep the record straight, I do not think I have said that IBM's dominance is due to its having done something. I certainly have not said that it is due to IBM's having done something in violation of the antitrust laws. I have tried not to make any comments about IBM's position in regard to the present antitrust laws.

As a general proposition, though, I subscribe to what I think in general terms you said was your hypothesis: namely, that IBM is a dominant firm in the industry because of something that is, not something that it necessarily does, if you want to distinguish between something that is and something that IBM does.

The question before this committee in its concern with the Industrial Reorganization Act, as I understand it, is not whether the economy would be better off if we prevented firms from doing things—to use an active verb—that monopolize or control an industry. The question is whether the U.S. economy and the public interest would be better served by correcting, once and for all, situations that involve a noncompetitive structure in the market, and in particular in an important market.

That is why I go back to IBM's dominance in the tabulating industry and say my view is that IBM got its large market share in the computer industry primarily by virtue of having dominated the tabulating industry, getting, in effect, a head start over all of the other competitors.

IBM has maintained its market position because of a number of structural factors, prime among which is brand loyalty and customer captivity. And it is not really necessary—at least I do not see that it is necessary for purposes of discussing the act—to decide whether customer captivity is something that just automatically exists or whether it is something that exists because IBM made it that way. The answer is that the industry is dominated by a single firm for historical reasons and the domination has been maintained by a structural feature. And the next question is would the economy be better off if that dominance were changed? As I said, my answer to that question is "Yes."

Obviously, if one does not believe, as some proponents of other arguments seem to feel, that this dominance is a problem, then certainly one does not need structural reorganization. If one wants to ascribe to economies which one feels almost by hypothesis are worth preserving, any of the advantages that account for dominance, then obviously the conclusion is that one does not want to do anything about such dominance as it exists.

Mr. GRANFIELD. I think what you are saying is that somehow an industry becomes dominated by a leading firm, that dominance is locked in, it is inevitable and, therefore, competitive pressures will not remove that dominance and you must do something about it.

Yes; I see in my counterhypothesis the following: If we see a firm in an industry involved, dominated by one firm, that firm can only preserve that dominance by continued superior performance.

United States Steel once dominated the steel industry. American Tobacco once dominated the tobacco industry. In subsequent years they lost their dominance because they no longer performed as efficiently as their competitors. Consequently, they were punished.

Now, what I hear you saying is that if there is a dominant firm it stays dominant because—my hypothesis of superior performance—it was not prudent enough to be a superior firm and let the market erode its dominant position.

I am very concerned about that because if these firms preserve their dominant position, there is nothing inherent in keeping a dominant position once you get it.

We have innumerable examples where a dominant firm has lost its position. We will enforce restructure, in essence, punish it, for the remaining competitor. If it becomes a giant and is no longer competitive, then we will not. We will not force any statutory changes upon it.

In essence, you are telling me you wish to punish superior performance. That is what you are saying; because you think it is locked in.

Mr. MILLER. I am a little bit at a handicap in commenting because I do not want to talk about IBM's conduct in a way that might be construed as having something to do with present antitrust litigation, but let me give one example.

IBM's dominance is locked in, as I say and as I believe, largely by product differentiation. The effect of IBM's performance—and I am not sure "performance" is a good word, and "conduct" is not a very good word either—the effect of IBM's whatever it is doing that locks this situation in is IBM's ability to build computer products that are sufficiently different from what the other manufacturers are building, so that there is a substantial cost involved in switching from an IBM product, or an IBM computer system, to somebody else's computer system. Now, if you want to, you can characterize that as superiority, because that particular situation enables IBM to charge high prices for its product—prices that are sufficiently high to earn excess profits, but that are not so high that despite the cost they induce users to switch. If you want to call that superiority of management, I am perfectly willing to accept the proposition that that is superior management.

I am not willing to accept the proposition that that kind of superiority is of any benefit whatsoever to the customers of IBM or to the U.S. public.

And I believe that that particular pattern is very important to the computer industry, and that structural change will do something to stop that kind of behavior.

Mr. GRANFIELD. So you are saying that anyone who is a customer of total systems suppliers is locked in?

Mr. MILLER. I am saying that in the computer industry, not necessarily any other industry, but in the computer industry anyone who is a customer of a total system supplier in the present environment of

high product differentiation must pay a substantial cost penalty for changing to someone else.

Mr. GRANFIELD. But you only single out one firm. And that seems to be the firm that has performed most effectively in terms of selling a total systems package.

IBM is not the only one who does it. They seemingly do it better than other firms, I guess, because customers do not switch. You singled out one firm to end evil of a system lockout. You intend, in your organization, to allow the others to impose their costs on their customers.

Is not that mildly inconsistent?

Mr. MILLER. No, sir, it is not. The purpose of reorganization is not to punish IBM. The purpose of reorganization is to build a competitive structure in the industry. I believe I stated, and I tried to make it clear, that I feel that the result of having a competitive structure in the computer industry will be to have a decrease in product differentiation, because the forces of competition in that changed structural situation will, through market pressures, induce the manufacturers to decrease the product differentiation that they have.

I do not single out IBM for reorganization as a punitive measure. I simply observe that if one wants to decrease the seller concentration ratio, which I believe, from my analysis to be a key to determining the structural situation in the industry, it obviously will not be achieved by fragmenting everybody else; it will be achieved by dissolving IBM.

Mr. GRANFIELD. Then certainly after hearing you, I think your comments indicated you have given this a great deal of thought and I certainly respect that. Perhaps an alternative solution to the problem you perceive in this industry, in terms of customer loss—and this bothers me—is that we are going to determine that the customer does not know when he is better off, we are going to tell him when he is better off.

Let us leave that aside.

Mr. MILLER. I do not think I said that we were going to tell them. I simply said that I think we want a market situation in which the cost of allowing customers to choose each time they buy a product is reduced, that the customers do not face a substantial cost in moving from one supplier to the other.

We are not going to tell them that they cannot continue buying from IBM or from IBM's successors.

Mr. GRANFIELD. An alernative might be to let us just mandate certain kinds of standards that would reduce these trends. Of course, we do not have to break up IBM at all, we just have to mandate that all firms have compatible hardware or software and we can define "compatible" in terms of transfer cost.

Mr. MILLER. The only thing that bothers me about that is that I have always been from the school that believes that every time that we—the public, the Government—start telling people how to conduct their business, we find that the performance is not nearly so good as the performance is when we let market forces take care of things. That is the main argument in favor of structural reorganization: We do it once and we get out; and we let what happens in the marketplace happen. We don't set up some board to say, "You have got to meet these standards of compatibility; you have got to announce your product in advance; you have got to do this, that, or the other thing in order to give everyone else a fair chance."

I just do not think it works. I do not think it has worked very well in the industries that are presently regulated; although in some of them it is undoubtedly the best solution, and in others it is not.

I certainly would not be looking for the excuse to try it in the computer industry.

Mr. GRANFIELD. This is a standards regulation. That is somewhat different than some of the regulations.

But the "we"—the Government—will do the divesting, and I am kind of curious as to why we think we will have so much wisdom doing that when you claim we will not have wisdom doing it in certain other activities.

Mr. MILLER. I do not think we are so wise about divesting, but we will do it once and that is all; whereas if we have to sit there and regulate, then we will have to do it a lot more often. We get lots more chances to foul things up if we go into the regulatory business than if we go into the structural reorganization business.

Mr. GRANFIELD. But every time a firm achieves a dominant position you are going to go bust them up again.

Mr. MILLER. In my reading of the historical record there have been very few instances since 1890 or since 1911 when firms have achieved dominant positions. I can think of something like Xerox, which has achieved a dominant position, that is not related to some other base.

Other than that, the automobile industry concentration has increased but my recollection—and it is a dim one, of times in distance past, and I am not an expert on these facts—is that the really big increases in seller concentration in the U.S. economy occurred a long time ago. They occurred at a time when there may have been some question about how the antitrust laws were to be enforced, or they occurred as a result of loopholes—what I would characterize as loopholes—in the merger laws prior to 1950.

I would certainly think it appropriate to reconsider the reliance on structural reorganization, if you could put together a record that shows that there was a strong tendency for concentration to develop or increase in unconcentrated industries the American economy in the postwar period.

Mr. GRANFIELD. I think we could go on for a very long time. I do thank you very much.

Mr. MILLER. I think you for the opportunity of appearing.

Senator HART. Thank you very much.

I anticipated we might be able to continue without a recess. After checking with our remaining witness, Professor Brock, I am being advised that his plane does permit him to stay awhile. I suggest a recess until 2:30.

[Whereupon, at 1:10 p.m., the subcommittee recessed, to reconvene at 2:30 p.m. this same day.]

MATERIAL RELATING TO THE TESTIMONY OF RALPH E. MILLER

Exhibit 1.—*Prepared Statement of Mr. Miller*

PREPARED STATEMENT OF RALPH E. MILLER, ECONOMIST, WASHINGTON, D.C.

My name is Ralph E. Miller, and I am an economist living in Washington, D.C. I have a master's degree in economics from Harvard University. My interest in the computer industry began in the mid-1960's, when I was still a graduate student at Harvard. At that time I started work on a doctoral dissertation that was intended to be a study of the structure and performance of the computer industry. After leaving graduate school, I was an Acting Assistant Professor

of Economics at the Berkeley campus of the University of California. I taught the undergraduate and in one year also the graduate course in industrial organization and public policy. While at Berkeley, I was also a consultant to the counsel for Control Data Corporation, and I assisted them in the development and preparation of their antitrust suit against IBM.[1] I then moved to Washington, where I joined a consulting firm, and one of my clients was Sperry Rand Corporation. I assisted Sperry in the antitrust aspects of their patent and antitrust litigation with Honeywell.[2] During this period, I also presented an invited paper on "Public Utility Aspects of Computer Use" at one of the seminars sponsored by American Telephone and Telegraph Company on Problems of Regulation and Public Utilities.

Most recently, I was employed for almost a year in the Antitrust Division of the Department of Justice, where I was assigned to the *IBM* case.[3] I left that job to move to my present position, and I mention it only to emphasize that my statement today will not draw in any way upon confidential information that came to me in my work at the Justice Department. Nor shall I reveal any proprietary data that I had access to in my other consulting activities, but my consulting experience has of course helped to shape my views on the computer industry.

To ensure that the record is kept straight on the sources of my information, I have based my statement today upon my still incomplete dissertation manuscript, which was given privately to a few persons for review at various times prior to my entry on duty with the Justice Department. This manuscript covers the period through about 1969, and I trust that the Committee will understand why I have limited my detailed consideration to this time period.

Because of my past association with the Department of Justice, I shall also refrain from comment about the pending *IBM* case. Specificially, I shall not comment on whether I believe IBM is or has been in violation of the antitrust laws since 1960 (the period of the complaint) ; nor shall I comment on remedies appropriate in the event that the court finds for the United States in that case.

I do intend to assess the present structure of the computer industry, and to comment on the merits of several possible ways of restructuring it, but these views are based solely on economic considerations—they are not views of what the present law does allow or should be interpreted to allow.

Finally, I must emphasize that the views I present here are my personal views, and they are based on my personal study of and experience with the computer industry. I am not representing my present employer, or any past employer or client, or any federal agency ; and my views are not necessarily those of any of these other parties.

In this statement I first give my views on what the computer industry is. I then present data that I believe show the industry to be dominated by IBM, and I try to explain how IBM achieved and maintains this dominant position. I then consider the question whether a more competitive structure for the computer industry is likely to be in the public interest. Answering this question affirmatively, I present and evaluate several possible ways the needed restructuring might be achieved. I close with a few remarks about the relevance of this analysis in an industry changing as rapidly as is the computer industry.

THE COMPUTER INDUSTRY

One of the first questions that must be confronted in discussing the computer industry is the question of what the computer industry encompasses. My own view is that the industry is most clearly seen as encompassing the production and initial marketing of general purpose electronic digital computers or computer systems. Computers are the pieces of machinery and equipment themselves—the so-called "hardware"—while computer systems also include the principal programs ("software") needed to make the computers operate effectively, together with other essential support customarily provided by the manufacturers of the hardware.

The decade of the 1960's was a period when the computer of general purpose electronic digital computer systems was especially clear. Almost all computer installations were confined to a single site, and the boundary between equipment in the system and equipment not part of the system was thus clear. Each computer system contained a central processing unit, where the arithmetic and logical functions were performed (the so-called "mainframe") ; plus devices

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1 *Control Data Corporation* v. *International Business Machines Corporation* (D. Minn.)
2 *Honeywell Inc.* v. *Sperry Rand Corporation et al.* (D. Minn., 4–67 Civ. 138).
3 *United States* v. *International Business Machines Corporation* (S.D. N.Y., 69 Cir. 200).

such as card readers, printers, and tape units which were used for the input, output, and storage of data (these are the so-called "peripheral" equipment). There has always been some peripheral equipment manufactured and sold directly by independents, but in the 1960's the mainframe manufacturers either made or distributed the great preponderance of the peripheral equipment, and thus it is appropriate to represent the mainframe manufacturers as purveyors of at least the complete hardware complement for computer systems.

During the 1960's there was also an especially clear distinction between general purpose digital computers and other kinds of electronic computing equipment. Computers built for use in weapons systems were designed to meet severe environmental specifications set by the armed forces, and they were not competitive with general purpose computers for non-military use. A clear illustration of this point is that the Department of Defense is the world's largest user of general purpose digital computers (unless one considers the entire federal government as a single user), in addition to being virtually the only customer for special purpose military computers. Some firms also manufactured computers and incorporated them into special purpose systems in such fields as communications, but the volume of business in these fields in the 1960's was very small relative to general purpose digital computers. The one exception is the manufacture by Western Electric of computer-like devices for use in the Bell System of telephone communications. Here the volume of business may have been appreciable, but the special relationship of Western Electric to the other Bell companies kept this activity insulated from the computer industry.

Finally, the 1960's was a period when it was especially easy to distinguish between the software and services included in computer systems and those that were not so included. The principal reason for this is that during the 1960's the major computer manufacturers sold their systems on a "bundled" basis—that is, they typically charged a single price based on the hardware, with the systems software and essential supporting services supplied without separate charge. The computer system was thus the complete package offered by the mainframe manufacturer; and with few exceptions no other vendors supplied parts of the system directly to users, because few users would pay an independent vendor for something the hardware manufacturer supplied "free".

In addition to the software and services included with computer systems, there are other types of software and services used in electronic data processing (EDP), but not part of the computer industry proper. The so-called "system software" included in a computer system encompasses only the principal program packages needed by virtually all users for effective use of their computers. Examples are the "compilers" and other programs that translate from higher level languages congenial for programmers into the brutally simple and elemental instructions that computers can understand and execute; and the programs that schedule the internal operations of the various components of a computer system, to ensure that they are kept as busy and productive as possible. Most computer programs are "applications" programs that do the specific data processing work of the user, and they are not part of the computer system as defined here. Most applications programs are written by the users themselves. Some, especially those for the more widely used applications such as payroll, are written and sold by so-called "software houses"; and some are offered by the computer manufacturers themselves, either bundled with the system or for an extra fee.

Also in EDP but not in the computer industry inself are markets for the services of the existing stock of computer systems. Computer leasing companies purchase computers from the manufacturers and rent them to users, usually for a term of one or more years. Owners of computers often sell the use of their computer systems during the hours or even the entire working shifts that they do not need them themselves. "Time-sharing" vendors sell the use of "part of a computer" to numerous small users, in an arrangement where each user can connect his own terminal to the shared computer over a telephone line. Service bureaus offer computer time, but they also offer "one-stop" shopping for EDP services, providing a substitute not only for the user's computer system, but also for the programmers, keypunch operators, and other personnel needed to use EDP. In payroll, for example, a service bureau may take a handwritten record of the number of hours worked by each worker during a pay period, and from it generate the payroll checks, the business accounting records, the payroll tax reports to the government, etc. Vendors in all of these market areas are outside the computer industry, because they do not produce computers or computer systems. Instead, they must purchase their computer systems from the computer manufacturers, and thus they cannot properly be said to compete in the computer manufacturing industry. To some extent, the computer manufacturers are themselves

engaged in these areas, often through separate corporate divisions or subsidiaries, but this activity is still extraneous to the computer industry.[4]

Even with a relatively narrow focus on general purpose electronic digital computer systems, the computer industry is a large and important one in the U.S. economy. As shown in Table 1, value added by manufacturing in the computer industry has risen from 0.4 percent of the total of all manufacturing in 1958 to 1.0 percent in 1972; and the outlook for the foreseeable future is that the computer industry will continue to grow more rapidly than the economy as a whole.

TABLE 1.—THE COMPUTER INDUSTRY IN RELATION TO THE U.S. ECONOMY

	Shipments of electronic computers (millions)	Value added in manufacturing		
		Computer industry (billions)	All manufacturing (billions)	Percent
1958	$324	$0.6	$141.5	0.4
1963	880	1.3	192.1	.7
1967	1,973	1.9	262.0	.3
1972	4,362	3.6	348.0	1.0

Source: Department of Commerce, Census of Manufactures.

The economic activity occurring within the computer industry is, however, an understatement of the importance of computers to the United States and its economy. Computers are used prevasively throughout business and government. and they are intimately associated with two of the vital functions of what may be called the post-industrial society, namely decision making and record keeping. Computers run our oil refineries and our electric utilities. They keep our business and financial records. Without our computers, our society would grind quickly to a halt.

IBM'S DOMINANCE OF THE COMPUTER INDUSTRY

Because the computer industry is so important to the United States and its economy, it is proper that the structure of this indusry receive special consideration in the proposed Industrial Reorganization Act (S. 1167) and in this Committee's hearings on the Act. The outstanding structure characteristic of the computer industry is its dominance by a single firm: International Business Machines Corporation. Owing to the illustrious record of this Committee, and to the work of the many experts who over the years have appeared here, it is not necessary for me to explain the importance of seller concentration. I shall therefore turn directly to the record of IBM's dominance of the computer industry, as I see it.

I find that the best single way of measuring market shares in the computer industry is by reference to the total outstanding stock of general purpose computer systems, which is sometimes called the installed base. This choice results from consideration of the technical merits of the various possible measures, and from judgments about the quality of the data available for each type of measurement.

Shares of the installed base of computer systems are shown in Table 2. These shares are calculated from censuses of computer installations. Each census states how many computer systems of each model are installed on the census date, and what the average rental price is for each model. The total value of the installed stock of each model is the number of installations times the average monthly rental price. The total value of the installed stock for each manufacturer, and for the industry as a whole, is obtained by summation over the appropriate models. The data in Table 2 are based on the installation censuses printed in Computers and Automation (through 1962) and in EDP Industry and Market Report (thereafter), because I believe them to be the most reliable data that are available to the public. However, it must be kept in mind that these so-called censuses are in fact incomplete market surveys taken by private firms, and they are subject to an unknown margin of error.

The period through February 1958 represents the beginning of the computer industry, and the market shares in Table 2 show that only the earliest entrants played a significant role. Even Honeywell and RCA, which do appear in the 1958 census, had installed only one and three computers, respectively, and the

[4] The foregoing description is offered primarily as a background for the analyses that follow. The author does not wish to suggest that either the concepts or the factual assertions are necessarily appropriate to any litigation under the present antitrust laws of the United States.

size of their shares is a vivid reminder of how small the market was then. On the other hand, NCR had considerable experience with military computers, but this is not reflected in a tabulation of shares in the general purpose market. Computers installed in January 1960 were still overwhelmingly first generation (vacuum-tube) systems, and the years 1958 and 1959 are thus the height of the first generation. However, by 1959 the market was looking toward solid-state systems, though only a few were being produced, and this period is thus in some ways a transitional one—Burroughs retained a strong grip on third place in January 1960 by concentrating its efforts on the vacuum-tube model B–220, but it paid the price by performing very badly in 1960 and 1961, when only solid-state computers were selling well, and it had fallen to sixth by January 1962. The second generation (transitorized computers) continued through 1964, with 1965 another transitional year (note the relatively small increase in the installed base from January 1965 to January 1966), and 1966 marks the beginning of the third-generation (integrated circuitry) boom.

The principal observation on Table 2 is that IBM dominates the computer industry, with a market share in the neighborhood of 70 percent, and there is no one firm with a strong second position. Table 2 does not indicate any clear trends in IBM's market share. This share has fallen a few percentage points from its 1958–1969 plateau, but the decline was essentially complete by January 1962, with only mild undulations thereafter. The decline from January 1965 to January 1966 marks IBM's changeover to its System/360 line of computers, and the surge to January 1968 reflects the final arrival of all the basic models in System/360 to full production. The conclusion, then, is that IBM had a few exceptionally good years toward the end of the first generation, when Univac was in disarray and before other competition could make itself felt strongly, but there is no evidence of a trend in IBM's market share in the second and third generations, nor does the approximately 70 percent attained then differ from IBM's early achievements, up to late 1956.

The clearest trend visible in Table 2 is the decline of Univac. The main decline in Univac's share of new production was already complete by 1957, but there was a further small decline in the 1960's after a plateau from 1963 through 1965. The decline in Univac's share of the installed base, as shown in the table, is both slower and more persistent (and therefore more easily spoted as a trend), because the vestiges of Univac's former eminence did not disappear from the computer stock until 1964.

It is also clear from these aggregate market share data that Control Data, General Electric, and Honeywell all carved out important positions in the non-IBM part of the computer market. Control Date did so quickly, in the five years from 1960 through 1964, whereas Honeywell and General Electric experienced longer and slower gains. Other firms with upward trends are DEC, SDS, and perhaps NCR, though no one of these has gone so far or so fast as did Control Data, General Electric, and Honeywell. Finally, the shares of Burroughs and RCA seem to be approximately stable.

Behind IBM, no one firm has a strong hold on second place. Univac held that position through January 1969, but by a decreasing margin, with Honeywell, General Electric, and Control Data all challenging for the second position, and RCA not much further behind.

The foregoing description of market shares has used data only on the installed base of computer systems. Two other measurement bases are also commonly discussed: revenue; and the value of current production and shipments. Each measurement basis has its advantages and disadvantages, primarily of a technical nature. But when the data are tallied, the scores do not differ by more than a few percent, and these differences are too small to be of major concern in the context of this inquiry. The reasons for this judgment is that both economic theory and empirical evidence indicate that the difference of a few percentage points in, say, the combined market shares of the top four firms is not likely to have much effect on either the conduct or performance of an industry.[5] In the computer industry, it is easily seen (and already well known) that there is a very high degree of seller concentration. It is equally clear that this high level of seller concentration is due to the overwhelming size of a single firm, rather than to the presence of several firms, each with a moderately large market share. Beyond this, there is nothing that further study of market shares can reveal about seller concentration as a static element of market structure. I therefore turn now from the question of whether IBM dominates the computer industry to the analytically more challenging question of how and why this dominance was achieved and maintained.

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[5] Joe S. Bain, Industrial Organization, ch. x, especially pp. 413–314.

TABLE 2. MARKET SHARES OF INSTALLED BASE OF GENERAL PURPOSE ELECTRONIC DIGITAL COMPUTER SYSTEMS, INSTALLED BASE

[In thousands of dollars]

	September 1956	February 1958	January— 1960	1962	1963	1964	1965	1966	1967	1968	1969
Total monthly rental value of all general purpose electronic digital computer systems	6,930	14,105	31,513	58,431	82,280	108,151	155,373	202,007	308,591	437,420	554,868

MARKET SHARES

[Percent]

	September 1956	February 1958	January— 1960	1962	1963	1964	1965	1966	1967	1968	1969
IBM	70.5	76.0	75.8	72.6	71.8	71.3	71.1	67.9	69.8	72.2	69.2
Burroughs	3.2	3.2	2.7	1.7	1.9	2.4	2.5	2.8	7.3	2.2	2.5
Control Data				2.0	2.3	3.8	4.4				
Bendix [1]	.4	1.1	1.1	1.2	1.1			5.2	4.7	4.2	4.5
Librascope [1]		1.9	1.3	1.2	.8	.8	.5				
Digital Equipment					.2	.2	.2	.3	.4	.4	.4
General Electric				1.6	2.1	2.3	1.7	2.5	3.4	3.5	4.1
Honeywell		.3	1.0	2.0	1.8	1.8	2.6	3.9			
Computer Control [2]					(3)	(3)	.1	.1	5.2	4.7	4.9
NCR			.1	.8	1.7	2.4	2.7	3.0	2.2	2.3	2.9
RCA	3.2	2.4	1.8	3.3	3.5	3.9	3.4	3.1	2.7	2.6	3.3
SDS					(3)	.1	.3	.5	.6	.7	.8
Univac	21.9	15.0	15.1	11.6	10.4	8.5	8.7	9.1	7.7	6.5	6.8
Others	.8	1.1	1.0	2.0	2.5	2.5	1.9	1.7	1.0	.8	.6

[1] Acquired by Control Data. [2] Acquired by Honeywell. [3] Less than 0.05 percent

HOW IBM ACHIEVED AND MAINTAINED ITS DOMINANCE OF THE COMPUTER INDUSTRY

Identification of the factors accounting for IBM's dominance of the computer industry is needed to facilitate consideration whether structural change in the industry is desirable and feasible. These fatcors fall into four classes. First, there are some advantages of large scale in the computer industry. These are advantages that accrue to any firm that is bigger than it rivals, and that thus tend to destabilize a competitive market structure. Second, there are structural characteristics tending to stabilize market shares. These forces work against the creation of market dominance from a competitive situation, but they also help preserve market dominance if it can once be achieved. Third, IBM has some special advantages in the computer industry, which it owes to historical circumstance. Finally, IBM's conduct in the market has itself had a impact on the structural basis for market dominance, and it may or may not also have involved repressive and disciplinary practices that have characterized some other monopolies in the past. These four groups of factors are considered in turn.

The first set of explanatory factors are advantages of large scale, and the first of these to come to mind are economies of large scale (lower unit costs at higher rates of output). The classic locus for scale economies is in the production of goods, which in the computer industry encompasses the manufacture of components, their assembly into complete units of equipment, and the design and development activity associated with the manufacturing process. In the first half of the 1960's the economies of large scale in the area were not substantial relative to the size of the market. But in the second half of the decade, and more specifically with the arrival of integrated or hybrid integrated circuitry, the situation may have changed. One estimate by a knowledgeable but anonymous observer placed IBM's direct costs of hardware production as much as one-fourth or one-third lower than the direct costs of its rivals. With typical direct costs (for everyone except IBM) a bout 30 to 35 percent of selling prices, this advantage, expressed relative to revenues, may give IBM a margin of as much as ten percent over its rivals. More recent judgments by other observers have questioned this conclusion, and several experts familiar with the industry's cost structure believe that IBM has essentially no production cost advantages due to economies of large scale.

The true picture of scale economies in computer production is very difficult to discern, even with better information than is available to the public, and this for two reasons. First, measurement of the product is so difficult that what are thought to be cost differences are in fact product differences.[6]

Second, IBM's scale of operations is at least a full order of magnitude larger than any of its rivals (this margin may have fallen to a factor of about seven with the Honeywell acquisition of GE's computer business in 1970), and the market therefore offers no experience showing whether the scale economies, if any, enjoyed by IBM could be achieved with only ten or thirty or fifty percent of the market.

A second locus for advantages of large scale in the computer industry is in marketing and distribution, including maintenance. Here it is generally agreed that IBM has substantial cost advantages that result from its large scale. However, it is not clear that these cost advantages reflect anything more profound than the high success ratio that must attend the marketing efforts of a firm with 70 percent of the market. IBM obviously does not dissipate a large fraction of its sales effort on customers it eventually loses, whereas its rivals do bear a much greater burden of fruitless sales calls.

The third of the advantages of large scale in the computer industry is the benefit from external economies in the use of computers. External economies are benefits derived by each user of computers from the activities of other users. Owing to product differentiation, the external economies created by installations of one computer model benefit primarily the other users of computers of that model. The nature of these external economies is described first. Then it is shown that they redound to the benefit of the computer manufacturers, and that the benefits derived by each manufacturer are directly related to its share of the computer market.

[6] As an analogy, suppose the existence of extreme product differentiation made it possible for General Motors to sell its Chevrolet Vega for the same price as Chrysler's much larger Dodge Dart. An observer unable to identify the size differences between the two cars would still note GM's lower costs, and they might well be attributed to economies of large scale. But the proper explanation of the postulated situation is that GM's product differentiation advantages enable it to sell a smaller and less expensive product for the same price as its rival sells a larger and more expensive product.

External economies in the use of computers occur in five ways. The first is in the market for computer time. It is a rare user who needs all of the time on his own computer, and never anything more. If for no other reason, this is true because the computer may break down at a crucial moment when data must be processed; but even if the average load is very close to capacity, the load is apt to fluctuate from day to day (or hour to hour). One way to deal with periods of excess demand (or overcapacity) is to buy time on another computer like one's own (or sell one's own surplus time). But the market for computer time can operate successfully only if the number of participants is large enough so that during most time periods the random fluctuations of the different users' supply and demand are canceled by averaging.

Exactly paralled to this argument is one concerning the market for used computers. Since brokerage is clearly subject to economies of scale in the relevant range, and since savings in it are apt to be passed on to the owners of the hardware, the more widely used a particular model, the less it depreciates. The prospective saving in transportation costs—because buyers and sellers of used computers can be more closely matched in space, the larger the number of transactions—also reduces the depreciation of computers used in larger numbers.[7]

The third source of external economies in the use of computers is the market for programming services and other assistance in the use of computers, as they are provided by service bureaus, software houses, and EDP consultants. These firms are apt to have more experience in working with a more widely used model, and this greater experience makes it easier for a user of such a model to obtain help from them.

User organizations are a fourth source of external economies. They offer, in addition to exchange of programs, everything from advice about running an EDP shop to a semi-annual junket for the shop's chief. And despite the frequent criticism that junketing is the only "benefit," there is little doubt that the existence of a user organization does add to the desirability of the model it represents. The larger the user organization, the more programs there are to exchange, and thus the greater the benefit to each individual user.

Finally, the software for a widely used computer system gets debugged faster than for a less widely used model, because greater use uncovers the bugs faster.[8]

An important characteristic of these external economies is that their amount is greater, the larger the number of installations of a computer model. They are thus external economies in the Marshallian sense of reducing costs within an industry as the scale of production in that industry increases.[9] The benefits, however, need not go to the firms using the production process subject to external economies (in a competitive industry in the long run, nothing benefits the producers). Instead they may accrue to factors of production used in the process subject to external economies, because they raise the demand schedule for those factors relative to the demand for factors of production used in closely substitutable processes not benefiting from these external economies to the same extent.[10]

In EDP, the process subject to external economies is the use of a particular computer model, along with complementary inputs, to process data electronically. Since the use of EDP is atomistic, and since all the inputs except computers are atomistically supplied, each computer manufacturer is able to appropriate the value of the external economies obtained in the use of its computers (which the manufacturer does by charging a higher price, or by attracting more customers with a price that does not fully recover the value of the external economies). Finally, since the amount of the external economies is directly related to the num-

[7] To the extent that manufacturers act as brokers for both time and used machines—the former in service bureaus, the latter owing to the prevalence of leasing—these advantages may be interpreted as scale economies in distribution. This means that manufacturers benefit directly by internalizing these external economies, rather than by the indirect process described in the text, infra.

[8] Put differently, the more users there are, the fewer bugs each one discovers and is delayed by.

[9] Alfred Marshall, Principles of Economics (8th ed.; New York: Macmillan, 1948), pp. 266, 271–72. Marshall repeatedly emphasizes the parallelism between external and internal economies—the latter depending on the scale of the firm, the former depending on the scale of the industry.

[10] The external economies also tend to lower the price of the product produced by the process benefiting from them. But in the case of EDP, the services produced by different computer models are so closely substitutable that their relative values can hardly be affected by differences in the cost of obtaining these services. Rather, what must happen is that these cost differences will be absorbed by the manufacturers of the widely used models as economic rents, or they will be used to keep computer prices below the point where firms not benefiting indirectly from external economies to so great an extent are driven from the industry.

ber of computers of a model in use—that is, to the market share of the manufacturer, given the total demand for computers, the larger manufacturers stand to gain more than the smaller ones.

The last major advantage of large scale in the computer industry is the benefit that comes from being the dominant firm in an industry where product differentiation and integration are extremely important. Electronic data processing is a complex of interrelated activities involving much more than just the production of computer systems, and IBM's great size enables it to enfold more of these activities than its rivals. This integration enables IBM to relieve the customer of some of the responsibilities and work of using computer systems to achieve results in his business. In contrast, customers of other manufacturers are forced to learn more about what they are doing in EDP, because the other computer manufacturers do not have the broad expertise to step in and help run their customers' businesses. IBM also benefits from its large size even in the areas where it is not integrated. Firms offering products and services for use with computer systems, such as digital communications equipment, plotters or other specialized peripherals, and tailored software packages, must all achieve a proper interface with the computer systems their products complement IBM's dominance of the computer industry permits it to in effect establish the standards for these interfaces, to which the complementary products are designed; whereas IBM's rivals must adjust to the market (which really means adjusting to IBM) instead of having the market adjust to them.

Related to these two points is the way that product differentiation and IBM's image of dominance affects the motivations of the corporate executive choosing a compuer for his firm: it is said that no vice president for EDP has ever been fired for choosing IBM, even when the new computer system failed to live up to the expectations of top management; but many have been fired for not choosing IBM. The point is that some mistakes are always going to be made in computer procurement, but top management will not second-guess against the choice of the dominant firm, and the safe course for the middle-level executive making the decision is therefore to stick with the leader.

The second major group of factors explaining IBM's dominance of the computer industry contains the forces that tend to stabilize market shares. Chief among these forces is product differentiation, which is even more important here than as an advantage of large scale. Product differentiation tends to stabilize market shares because it tends to make computer users captives of their current suppliers, and most of the demand for computers is a demand for the expansion or replacement of existing systems. Customers are captives of their suppliers because their applications programs, their communications equipment, and their entire EDP experience are compatible only with systems produced by their current supplier. Expansion or replacement with compatible computer equipment is thus essential to the avoidance of large conversion costs, and owing to product differentiation this compatibility is ordinarily found only in the product line of the current supplier.

One other factor is significant among those tending to stabilize market shares. This factor is the impact of the extraordinarily rapid growth of the computer industry as a whole. In this hothouse environment, it is an enormous task for a firm to acquire, absorb, and organize the factors of production—both labor and capital—needed merely to keep pace with the industy. One may well ask how a firm might be expected to increase its share of the computer market from two or three percent to five, ten, or twenty percent in, say, three, five, or ten years, when it must double in size every two or three years (as in the 1960's) merely to avoid losing in market share. Yet growth potential in this range is exactly what was needed to reduce IBM's dominance of the computer industry.

The third group of factors explaining IBM's dominance of the computer industry are the special historical circumstances that attended IBM's rise to dominance. In a period of five years, from 1951 to 1956, the computer was transformed from an engineering tool, built and used by engineers, into a commercially manufactured product, built in quantity and sold for use on a wide variety of problems. The story of this transformation is one of the great tales of entrepreneurship, and it is the story of IBM's success and Univac's failure.[11]

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[11] This story has long been a legend in the computer industry. George Schussel ("IBM vs. REMRAND," Datamation XI, Nos. 5 and 6 [1965]) has recorded the story, examined it carefully, and verified the legend behind it. The account here draws extensively, and without further citation, on Schussel's work.

Univac was the creation of Eckert and Mauchly.[12] After producing the ENIAC and doing much of the work on its successor, the EDVAC, they left the University of Pennsylvania to go into EDP for profit. Striking out alone, they established a small corporation, which quickly obtained a contract to sell a Univac I to the U.S. Bureau of the Census. In 1950, with the first Univac I not yet finished, Eckert and Mauchly sold out to Remington Rand, joining its new Univac Division in high executive posts.

The first Univac I was finally delivered to the Census Bureau in March 1951, and the model was made available to other buyers (over 30 were eventually sold). It was the first stored-program computer and the first computer of substantial scale to be sold commercially. When it appeared, IBM offered nothing better than the older Card-Programmed Calculator, though it had begun developing the IBM 701 late in 1950. First deliveries of the 701 began in 1953, almost two years after Univac I, but not much more than two years after development had begun. In contrast, development of Univac I had started in 1947, and there were many revisions before the model was finally put into production.

Univac, having established a lead in powerful computers with Univac I, held it until 1956, when the appearance of the IBM 705 and 704 tipped the balance the other way.[13] There are several reasons for this swing. First is salesmanship. Remington Rand was a poor second to IBM in the office machinery business, and its sales force was thin, if not seriously understaffed. Called upon to sell computers for business use, and therefore to the same group of customers it had always been dealing with, it was unable to bear this additional burden as well as was IBM's large sales force. Moreover, IBM had long had the attitude that it was selling data processing services, not office machinery. This attitude was extremely appropriate when data processing became electronic and computers were added to punched cards: obtaining data processing services from computers turned out to be much more difficult than producing the hardware itself. IBM's attitude led it to provide much greater assistance in using computers than did Univac; and since this assistance, rather than hardware, is what customers needed, they bought from IBM.

The growth of business EDP, which IBM pioneered through its effective sales force, marks the ascendancy of IBM. Univac initiated this growth, but in so doing was unfortunately involved in a fiasco. The installation of a Univac I in 1954 at the General Electric plant in Louisville was widely regarded as a major advance in business EDP. The computer was supposed first to take over the payroll computation and then add other data processing work. But failure to provide adequate programs delayed its use for a number of months after the computer was installed, and Univac acquired a bad reputation.[14] The problems were no direct fault of Univac, in the sense that the hardware performed as claimed. But if IBM offered customers help with programming, one can at least find Univac guilty of an error of omission in the battle for hardware sales.

Another disadvantage faced by Univac in the business EDP field is Remington Rand's position as poor second to IBM in the old tabulating card equipment industry. Univac therefore had fewer establishsd customer relationships and a much narrower range of sales contacts for computers. This disadvantage is highlighted by Univac's comparative success in scientific EDP and in sales to the federal government: in both of these areas, IBM too was opening new ground.

A further difficulty faced by Univac in selling its large computers (the 1100 series) is failure to develop a small computer model to follow Univac I. IBM came out with the 650 in November 1954, and eventually sold over 1,000 of them. Many went to customers who wanted a comparatively inexpensive trial for EDP, and later converted to the IBM 700 series. Univac's failure to provide a full line of equipment was thus another factor contributing to its slide from dominance. This can perhaps be called a management error, and it is not the only one committed by Remington Rand in regard to the Univac division. Schussel feels that

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[12] J. Presper Eckert and John W. Mauchly are the builders of the ENIAC, which is generally recognized as the first electronic digital computer. Their brief experience as independent entrepreneurs in the computer industry is typical of many tiny computer engineering firms that sold out to much larger corporations.

[13] Remington Rand's 1951 acquisition of Engineering Research Associates, manufacturers of a large scientific computer, contributed to this lead.

[14] The facts of this story (as told by Schussel) are disputed by John K. Swearingen (letter to the editor, *Datamation* XI, No. 8 [1965], 13), who worked on the GE project team when the Univac was installed. However, it is Univac's reputation, and not the facts, that are relevant to a history of the computer industry, and there is little doubt that the Louisville experience did give Univac a black eye.

poor management in several respects was a major factor contributing to Univac's lack of success.[15]

Technological leadership—one factor that might have helped explain IBM's dominance—is conspicuous for its absence. Instead, Univac is considered to have been a greater contributor to the art of computing. Univac hardware was certainly the equal of, and probably superior to, IBM's. True, IBM electromechanical equipment, used primarily for input-output operations, is generally considered to be the best in the field, but it was in the human aspect of man-machine communications that IBM excelled. This excellence in the field of computer applications was manifest in the superior customer assistance provided by IBM salesmen.

This historical sketch emphasizes IBM's entrepreneurship in achieving its dominant position in the computer industry. But it is also striking that the only competitor able to mount even an unsuccessful challenge was the only other firm in the tabulating equipment industry; and IBM and Univac emerged into the computer age in the same relative positions they held in the tabulating industry—with IBM dominant. More recent analysis has suggested two factors not emphasized by Schussel, but related to IBM's dominance of the tabulating industry, as contributing to IBM's rise in dominance. The first is the cash flow from IBM's lease base of tabulating equipment, which IBM could use to finance the rapid growth of its computer business. The second is IBM's ability to make tabulating equipment—especially that already in the hands of its customers—serve as input/output equipment for IBM computers.

One final historical item should also be noted: the consent decree of 1956. Just when IBM began moving strongly into the nascent computer industry, the U.S. Department of Justice instituted legal proceedings that were to have an important impact on the new industry's structure. In January 1952, the Justice Department filed a complaint against IBM, alleging a variety of offenses against Sections 1 and 2 of the Sherman Act. Four years later, the case was settled out of court by consent of the two parties, and the consent decree was filed and entered in January 1956.[16]

The complaint was directed primarily against IBM's dominance of the tabulating card and tabulating card equipment industries, but the terms of the consent decree were drawn to cover computers as well, and therein lies the importance of the consent decree for this study. Those provisions with significant effects on the computer industry will now be summarized.

(1) IBM was required to offer for sale all equipment that was generally available on lease, and the purchase prices had to have "a commercially reasonable relationship" to the rental terms. Leases were limited to a term of one year. Except for maintenance and repair, all services offered to lessees had to be offered free to purchasers; and maintenance and repair had to be offered at reasonable charges.

The importance of leasing as an exclusionary practice had recently become clear in the American Can and second Shoe Machinery cases.[17] These provisions prevented the gross abuses that had been discovered there.

(2) IBM could not prohibit the use of its equipment in a system with non-IBM components. IBM could not tie its maintenance to the purchase of its hardware; nor could it require the use of IBM tabulating cards by any owner or lessee of its equipment (not even as a condition relating to maintenance or warranty of the equipment).

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[15] Schussel also feels that IBM was never so far behind as some people have thought it was. It participated heavily in the construction of the Mark I and II at Harvard, and it also had a line of electronic calculators (including the CPC). The reason it was not yet in the computer business is that Thomas J. Watson (Sr.)—like almost everyone else—grossly underestimated the potential market.

[16] United States v. International Business Machines Corporation, CCH *1956 Trade Cases* ¶ 68,245 (S.D.N.Y. 1956). A summary of the complaint appears in Commerce Clearing House, *The Federal Antitrust Laws, With Summary of Cases Instituted by the United States, 1890–1951* (New York: Commerce Clearing House, Inc., 1952), p. 423.

[17] U.S. v. American Can Company, 87 F. Supp. 18 (N.D. Cal. 1949); and U.S. v. United Shoe Machinery Corporation, 110 F. Supp. 295 (D. Mass. 1953). For a discussion of leasing practices and their effects, see McKie, Tin Cans and Tin Plate, pp. 182–197, and Carl Kaysen, United States v. United Shoe Machinery Corporation (Cambridge, Mass.: Harvard University Press, 1956), pp. 64–73.

These provisions were attempts to split the integrated data processing market into segments that could be entered by smaller, specialized firms.

(3) IBM had to offer training to independent repairmen (including any users desiring such training), and it had to offer to sell parts and subassemblies to owners and to independent maintenance firms.

This was apparently a special effort to break open the technology of the equipment. It is noted here because scale economies in maintenance have become important in the computer industry, and, so long as maintenance is provided by manufacturers, these scale economies are an advantage of large size in the computer industry. It is therefore worth noting that the consent decree attempted to encourage independent maintenance and repair service.

(4) IBM was required to grant non-exclusive licenses under any, some, or all of its patents, at reasonable royalties (royalty-free, for patents reading on tabulating cards or tabulating card equipment), to anyone applying for such licenses. This provision covered all present patents, plus any that might be obtained for five years.

(5) IBM was required to place all of its service bureau activities in a separately organized, but wholly owned, subsidiary corporation (called the Service Bureau Corporation, or SBC). SBC was not to use the IBM name or any IBM facilities or personnel. It was required to keep separate accounts, and to cover its costs; and it was not to receive any favorable terms in dealings with IBM, unless those terms were offered to all other service bureaus.

As a group, the remedies in the 1956 consent decree were conduct remedies applied to the conditions in the tabulating industry as that industry was understood at the time. There is only one comment that need be made about them: they did not succeed in reducing IBM's dominance of either the tabulating industry or of the computer industry that grew out of it.

The final class of factors that may account for IBM's dominance of the computer industry is IBM's conduct in the marketplace. With the government's antitrust suit pending, it does not seem appropriate to discuss market conduct in detail. However, I would be remiss if I did not mention a few of the ways in which market conduct may (or may not) have affected market structure: (a) the extent of product differentiation may depend upon IBM's product policies; (b) the practice of bundling and integration of the product line is dependent upon product and price policies; (c) educational discounts and, in some instances, gifts of computers to universities may have increased IBM's penetration of the university market beyond what it would have been otherwise, thus capturing new entrants into the ranks of EDP customers while they were still training for their jobs; and (d) repressive and disciplinary practices may have been used by IBM to shore up its position in parts of the computer market where it was threatened.

The actual situation of IBM's sustained market dominance in the computer industry is the result of a balance among the various forces described above. My own view is that IBM's rise to dominance is due to a combination of historical circumstance (the dominant position in the tabulating industry) and good management, but not in any significant way to the advantages of large scale. I believe that IBM's continued dominance can be described primarily to the stabilizing factors, with considerable assistance from a pattern of conduct that (perhaps not deliberately, and perhaps not even knowingly) reinforced the structural features that tend to stabilize market shares in the pattern of dominance. Some advantages of large scale were also present, but their impact on market shares has in my view been offset by a price structure for IBM that yields very large excess profits.

A MORE COMPETITIVE STRUCTURE FOR THE COMPUTER INDUSTRY WOULD BE IN THE PUBLIC INTEREST

The question of monopoly profits leads to the issue that is the nub of these hearings on the proposed Industrial Reorganization Act (S. 1167): whether a more competitive structure for the computer industry would be in the public interest. The argument for structural change depends first upon the proposition that more firms are better than fewer; and the smaller the relatively large firms in a market, the better. The broad applicability of this proposition has been subject to great debate, and I have nothing to offer the committee that it has not

already heard from persons better able to comment than I am. Suffice it to say that the weight of economic analysis seems strongly to support this proposition.[18]

I do have some specific comments about the market performance of the computer industry, and some views on how and why it will be improved by structural change. The first aspect of performance is monopoly profits. There is no question that computer industry as a whole, and IBM in particular, earns excess profits. IBM's rate of return on the capital invested by the shareholders has for many years been in the upper half of the 15–20 percent range, and this is far above the average for all manufacturing or the rate needed to attract new capital. In relation to sales, IBM's profit rate has stayed near 25 percent, before taxes. This means that one dollar of every four received by IBM goes to profits or to profits taxes. But the elimination of monopoly profits is no gain to the public if it is achieved through a structural change that increases costs to the level of the monopoly prices. The public benefits from lower prices, not merely lower profits for IBM, and the question of monopoly profits must therefore be viewed as a matter involving cost performance and product performance.

One posible basis for IBM's monopoly profits is the ability to sell its products at higher prices than its rivals charge for equivalent products. This could result from IMB's product differentiation advantages, and from capturing the external economies that go to users of popular computer models. There is some evidence that such a situation did exist at one time in the computer industry, but the record is no so clear as one might want. If any such price advantages do exist for IBM, their dissipation by structural change will benefit the public.

A more likely result of structural change will be an improvement in product performance, especially in the areas of product differentiation and marketing. My judgment is that a change in the structure of the computer industry will be accompanied by a decrease in product differentiation and marketing activity. There will be greater modularity and compatibility of hardware, including peripheral equipment and related products, of software, and of services. The expertise in systems integration, which is a major and costly ingredient of the marketing effort, will pass from the computer industry to the users of computers; and that, I submit is where it belongs. Decreased product differentiation will permit firms specializing in short product lines to flourish in their market niches; and it will give scope for innovation along a broad front, using the "components' rather than the "systems" approach to technological change.

Increased user expertise will lead to greater efficiency and other improvements in the way computers are used. Some of the fiascos of overselling may be avoided. Special notice should go to the problems of computer security and computer fraud. These problems are in my view exacerbated by the ignorance that many managements have of electronic data processing techniques. Owing to this ignorance, the responsibility for ensuring that computers are not misused is divided between the user (who understands his own business, but does not know much about computers) and the purveyor of EDP services (who understands computers, but may know little of the user's business). The result is that the responsibility may fall into the crack between these two jurisdictions. In contrast, if changes in the structure of the computer industry lead to a diffusion of computer expertise throughout the user community, then there is hope that business management will be better able to cope with the security and fraud problems that have accompanied the information revolution.

Apart from the likely improvements in market performance, structural change in the computer industry will likely have benefits that are more social and political then narrowly economic. In our democratic society it is at best repugnant and at worst dangerous for a large fraction of our business and government to be dependent upon a single firm. Nor are the risks only political and social: even as an economic proposition, it is risky for most of the nation's eggs to be in

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[18] Bain, Industrial Organization, ch. xi; Kaysen and Turner, Antitrust Policy, pp. 114–116; and George J. Stigler, "The Case Against Big Business," Fortune, May 1952. An excellent series of essays on this subject is in Edwin Mansfield, ed., Monopoly Power and Economic Performance (rev. ed.; New York: W. W. Norton & Company, Inc., 1968); bigness is defended by John Kenneth Galbraith ("The Economies of Technical Development"); and this argument is attacked by Richard Nelson, Merton J. Peck, and Edward Kalachek ("The Concentration of Research and Development in Large Firms") and by Jacob Schmookler ("Market Structure and Technological Change"). Donald F. Turner ("The Antitrust Chief Replies") summarizes the arguments. Also see F. M. Scherer, "Statement,' in Industrial Organization and Public Policy, ed. by Werner Sichel (Boston: Houghton Mifflin Company, 1967).

one basket, especially when those "eggs" are as important to our economic diet as computers.

A related problem is that big business almost invariably leads to "big government," i.e. government intervention in what would otherwise be decentralized decision making in a free and competitive market. Where the big business is perceived by the Congress as a natural monopoly, as in the case of American Telephone and Telegraph Company's dominance of the telephone industry, the Congress has typically imposed economic regulation. Regulation has not always been a good solution to the monopoly problem, but it has been acceptable; and in some industries it may even be the best choice among unpalatable alternatives. But unnecessary monopoly also breeds government regulation, and in a much more insidious (and therefore more dangerous) way. Instead of a single regulatory authority, we find responsibility for economic decisions spread among several government agencies, and the resulting mixture of a political and administrative process is much less efficient. Automobiles are the clearest example, with the auto industry caught in the midst of a three-way tug-of-war: the safety boards want safer cars, the environmentalists wants less pollution, and the energy savers want better gasoline mileage. Each tries to impose its will by fiat, and it ends up being the responsibility of the Congress to decide what kind of cars Americans shall drive. It has not happened yet in computers, but it will happen if nothing is done to change the structure of the computer industry, to make it more competitive.

STRUCTURAL REORGANIZATION OF THE COMPUTER INDUSTRY

The proposed Industrial Reorganization Act (S. 1167) prescribes structural reorganization as the normal remedy for monoply. If it is accepted that the computer industry is a monopoly (under the standards of the Act), and if the structural change is in the public interest, then the only remaining question is determining a feasible and procompetitive reorganization plan.

The first point about reorganization is that it need involve only IBM. Even now, with Honeywell and Univac having absorbed all or most of the computer operations of GE and RCA, no firm other than IBM appears to hold more than about ten percent of the market, and four such firms would still fall below the seller concentration level presumed under the proposed Act to be a monopoly. Thus the principal purpose of reorganization is to break IBM into pieces no larger than the size of its chief competitors.

In considering a structural reorganization of IBM, it is most convenient to begin at the outside, with IBM's activities outside the computer industry. Other products that are important to IBM are electric typewriters and other office products; magnetic disk packs, tabulating cards, and other EDP supplies; and military electronic equipment, mostly special purpose computers. These products are produced respectively by IBM's Office Products, Information Records, and Federal Systems divisions, and these three divisions should be separated, either singly or jointly, from the successor computer manufacturers to IBM.

The Office Products Division does its own development and marketing, as well as production, and its Selective typewriter is the leader in its field. It appears, therefore, that this division would be viable by itself. If success in the office products field is dependent upon integration into at least some areas of EDP (though the separate divisional organization belies this contention), there are numerous small electronics firms that Office Products could later merge with to achieve this entry.

The Information Records Division should also be viable as an independent corporation, as there are several independent and successful firms in its lines of commerce.

The Federal Systems Division (FSD) is concerned largely with special purpose hardware for military use, and especially with digital communications. It also does a substantial amount of systems development work for the federal government and also for state and local governments. In all of this work, the division does its own marketing and manufacturing (except, of course, where general purpose IBM computers are used in complete systems that it supplies). Product design and some development work is also done at FSD's plants, but the division presumably relies on other IBM divisions for at least basic research. A firm with the size and product line of FSD would presumably have no trouble prospering—many firms of equivalent and smaller size do just that in the military electronics field. Some care might be needed to provide the division with a research capability, but IBM's Research Division operates several labo-

ratories; and FSD could if necessary establish its own, possibly being given some IBM personnel as a nucleus.

The second layer of structural reorganization is the reduction of IBM's integration across the various market areas in and closely related to the computer industry itself. Four market areas are important here: small information processing systems, peripheral equipment; electronic components; and software and supporting services. These are considered in turn.

IBM's small information processing systems are the successor to its tabulating equipment business. Development, U.S. manufacturing, marketing, and support are all concentrated in the General Systems Division. This divisional structure suggests that separation from the rest of IBM's computer business is feasible, though information published in the late 1960's indicated that the IBM plants manufacturing tabulating equipment also manufactured computer systems.[19] Separation of the small systems business from the larger computer systems is desirable, because it will help undermine the barriers of high product differentiation and tightly integrated product lines. IBM considered some such a cleavage feasible when it brought out the System/3 as a product line separate from the System/360–System/370 complex. The only "economies" likely to be present with IBM after this cleavage are the marketing advantages that result from knowing which users are good prospects for upgrading to larger systems, and these are private pecuniary advantages rather than savings of social costs. Separation of IBM's small systems business from its computer operations will open this group of prospective customers for all computer manufacturers, and it is thus clearly procompetitive.

Peripheral equipment presents some different problems. IBM has within the last several years transferred development and manufacturing responsibilities for at least some peripherals to its new General Products Division, and this may suggest the feasibility of separation from the rest of the computer systems business. However, this separation is not recommended as a key part of any reorganization plan. One reason is that the production of peripheral equipment occurs in the same plants as the production of main frames, and the two are so intermingled that it would be impractical to assign some plants to the peripheral equipment firm and others to the computer firm. Second, peripheral equipment as a whole is not a line of commerce. The term covers a variety of different lines of equipment related to computers, but many of these lines are not related to each other (e.g., magnetic tape drives and cathode-ray tube terminal display sets). There are indeed independent peripheral equipment firms, but they are specialists—none manufacturers as long a line of peripherals as even some of the smaller computer manufacturers. It might be feasible for IBM to divest some items of its peripheral equipment business, including specialized manufacturing facilities, but this is hardly the kind of remedy envisioned by the proposed Act for a broad monopoly of the computer industry. Finally the responsibility for architectural design of IBM's computer systems, apparently including peripheral equipment, is centralized in the Systems Development Division, and there may be some loss of real resource economies if peripherals are separated from their architectural moorings.

Electronic components are in some ways a mirror image of peripherals, but the conclusion is the same: separation from the computer business is of doubtful merit. IBM once had a Components Division, but its functions have now been absorbed into the System Products Division, which manufactures the central processing units for IBM's computer systems. When the Components Division was a separate entity in IBM, it had its own plants, and separation of components manufacturing thus appears feasible. But there may still be some economics derived from vertical integration in components, especially now that integrated circuits contain so much of the circuitry of a computer models on a single physical component. Since decreased vertical integration is not the medicine needed to increase competition in the computer industry, the case for it seems dubious.

Software and services present the clearest case for letting market forces determine the nature and extent of integration in an industry or industries. They have always been thoroughly integrated with IBM's systems design and marketing activities; and for at least some software products, such as operating systems, economies are attendant upon this integration. I have argued above that structural change in the computer industry may lead to decreased integration in software and services, but the transfer of these functions can best be accomplished in response to the market forces working against continued integration. In-

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[19] See, for example, IBM's 1967 Annual Report, p. 12.

deed, a reorganization plan that preceded the development of these forces would be unsuccessful in separating software and services from the successor computer manufacturers, because the resources—men and women—are mobile enough to flow right back to where the market forces are directing them.

The third layer of a reorganization plan, and the one directly indicated by the proposed Act, is horizontal dissolution of IBM's computer systems business. It will be a complex operation, even apart from the difficult job of unraveling a corporate financial tangle. In the case of IBM, the important physical assets to be divided are the manufacturing plants, the stock of leased equipment, and the laboratories. Important intangibles are patent rights, unpatented knowledge of the technology, software and support expertise, and customer relationships. The last of these will generally be associated with the ownership of leased equipment, and it may also follow such "liabilities" as exist under maintenance contracts or other obligations to owners of purchased equipment. The other intangibles are either finely divisible, because they are carried in the persons of IBM's many employees, or they are common goods that can be assigned to all the successor firms.

The physical assets require greater consideration. In 1968, when I last compiled publicly available data on this subject, IBM operated some twenty manufacturing plants and thirteen laboratories for its main line of computers, plus three components plants and a fourth planned. These counts include IBM World Trade Corporation, which conducts essentially all of IBM's operations outside the United States.

If World Trade can be included in the reorganization plan, then the plant structure is no obstacle to creation of half a dozen successors in the computer industry. If World Trade must be left whole, it should still be separated from all of IBM's domestic operations, to minimize the likelihood of World Trade's entering and dominating the U.S. market as IBM reincarnated. Even without World Trade, it should be possible to create at least four or five successors to IBM's domestic computer business. Since IBM's policy is to encourage some specialization of manufacturing plants by product, each successor will initially have a somewhat shorter product line than IBM as a whole; and within that product line, its output will be heavily weighted with the products for which its plants have had primarily responsibility. Similarly, the laboratories assigned to each successor will tend to have a broad basic competence, but a lopsided area of expertise.

The first feasibility question about this reorganization plan is whether it destroys any economic efficiencies presently enjoyed by IBM as a whole. In the short run, while the newly formed companies are confined to the short product lines of their manufacturing plants, they will lose most of the advantages of integration. These advantages, however, are of little consequence to the economy, especially in the short run. Most of them are merchandising advantages that benefit the integrated firm at the expense of its rivals, but that offer no gains for the public. The others arise only in or from the design process for new equipment, but when that occurs, the plant's product lines are changed anyway, and the firm is no longer bound to its inherited specialization.

Product changes thus mark the end of the short run, and in the long run the newly formed companies have the additional option of choosing the extent of their integration.[20] Most important, the long run in the computer industry is likely to begin very soon after dissolution, owing to the rapid pace of product changes. The question of efficiency, at least in regard to manufacturing operations, then becomes simply the question of scale: how large must the successor parts of IBM be in order to achieve the available economies of scale in manufacturing? The answer is not known, and one reason is that there is no historical experience with computer manufacturers even one-fifth as large as IBM, except of course for IBM itself. However, there are no apparently substantial economies of scale separating the firms with five to ten percent of the market from those having shares in the three-to-five percent range, so it seems likely that judicious specialization and selection of products can compensate for small total size in the computer industry.

Similar remarks apply to the other loci of scale economies that were discussed previously—new product development, field maintenance, and marketing—, and to the external economies in computer use. In each case, there is no good evidence

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[20] With the computer industry growing rapidly, the newly formed companies are apt to require expansions of their manufacturing facilities even before they introduce a new line of products. Plant expansion facilitates the addition of different products to the line, and it may thus cut even shorter the time the firms are restricted to their inherited product lines.

indicating just how far these economies extend. However, the discussion above does suggest that the important advantages of large size are not true social economies, and that the true economies can be achieved at a far smaller scale than that of IBM.

Component production does impose a minor obstacle, because there may not be enough component plants for each successor to have one. This is not an impossible situation, as there is an independent components industry, and even some moderate-size computer manufacturers do not presently manufacture their own components. Lack of integration may still be a disadvantage, but there is no obligation to make the successors to a dissolved firm start from positions of equality, and the unintegrated firms will of course be free to begin their own component production if they find it desirable.

The final observations on reorganization concern the installed base of leased equipment. One feasible reorganization is to distribute the leased equipment in accord with the manufacturing capabilities. But an added competitive fillup—and one that will probably help speed major changes in the division of labor among hardware manufacturers, service organizations, and users—may be to give the installed base of leased equipment to one or more successors not provided with hardware manufacturing capabilities. The Industrial Reorganization Commission may enjoy analyzing this particular twist early in its career.

EPILOGUE

The computer industry is changing, and many of the details of my story are half a decade out of date. This makes them ancient history by the standards of the computer industry. It may therefore be suggested that my analysis is no longer relevant, having been overtaken by events. In particular, it may be suggested that structural reorganization of the computer industry is not needed now, because other structural factors have changed in a direction favorable to competition. Some of the major product changes in the computer industry during the past few years are as follows:

Minicomputers: One can now purchase, for a price in the low tens of thousands of dollars, a computer as powerful as the largest computers in existence two decades ago. The minicomputer is small enough to sit on a table, and its purchase price is much less than the monthly rental charge for the computer system of the mid-1950's that it matches in computing power.

The marriage of computers and communications, which enables computers to work for a user whenever and wherever he wants.

The appearance of many new kinds of terminals, including point-of-sale terminals and other on-line or real-time applications systems.

A look at the participants in the computer industry shows that they too have changed. Two of the five leading contenders in the race for second place have left the field, their activities having been absorbed by two that remained. In 1970, General Electric sold its general purpose electronic computer business to Honeywell. In 1971, RCA simply departed; and after leaving, it sold its installed base of computers on lease to Univac. These consolidations have increased seller concentration at the top of the market, though they can also be viewed as the first steps toward transforming the computer industry from a near monopoly into some kind of oligopoly. At the bottom of the market there has been a proliferation of minicomputer manufacturers and of some types of peripheral equipment firms. These changes can be said by some to represent a strong increase in competition.

The last few years have also seen major developments on the private antitrust front. Control Data settled is differences with IBM early in 1973. Meanwhile the *Greyhound* and *Telex* cases went to trial, with IBM winning the former and losing (on the antitrust issues) the latter; but both cases are on appeal.

Those who use these developments as an argument against the desirability of structural change are in my view following the path that has since 1911 led away from effective antitrust relief. The general issues have been widely discussed, and it is not my purpose to add to an already lengthy literature. But there is one observation from the history of the computer industry that is germane, and it is this: Competition in the computer industry is, as I have explained, the supposed beneficiary of a major antitrust suit brought against IBM by the Justice Department in 1952, and settled by consent of the parties in 1956. The consent decree included some behavioral restraints but no significant structural reorganization, and the result is that we are here twenty years later with IBM's dominance now writ across a much larger and more important industry than the tabulating equipment industry was in the 1950's.

AFTERNOON SESSION

Senator HART. The committee will be in order. With apology again for holding him over, we welcome our final witness for today, Dr. Gerald Brock from the Department of Economics, University of Arizona.

STATEMENT OF GERALD BROCK, ASSISTANT PROFESSOR OF ECONOMICS, UNIVERSITY OF ARIZONA

Dr. BROCK. Thank you, Senator. I appreciate the chance to be here today. In the light of Mr. Katzenbach's statement on Tuesday, I would like to clarify my role in the pending antitrust cases before I get into my regular statement.

Mr. Katzenbach stated on Tuesday: *

> Professor Brock recently completed, under the tutelage in part of one of the Government's principal experts, a Ph. D. thesis on the computer industry, which is an important source of the Government's theory of the case against IBM.

My Ph. D. thesis was on the computer industry, but was done under the direction of Harvard economists Richard Caves and Marc Roberts, neither of whom have any connection with the Justice Department suit.

I have never worked for the Justice Department or any other participant in the pending antitrust suits in the computer industry. I have studied the computer industry as an academic economist with no preconceived ideas of the results of the study, or commitments to any of the conflicting interests in the computer industry.

So far as I know, my work has had no effect on the Justice Department's case.

The computer industry is of special interest to academic economists such as myself because of its unusual market structure and rapid technological progress. I have been studying the industry for the past 3 years in an attempt to bring economic analysis into the debate surrounding potential Government action toward the computer industry.

My statement will concentrate on how the industry's price and product policies are related to the industry structure. By industry structure, I mean, primarily, the concentration of firms and barriers to new firms entering the market.

IBM's market share as computed by three different sources is shown in table 1 of my prepared statement. The three computations each have somewhat different bases, and the figures do not exactly agree. However, they are close enough that we we may conclude with confidence that IBM's market share has been in the 65- to 75-percent range.

[Dr. Brock's prepared statement appears as exhibit 1 at the end of his oral testimony.]

Dr. BROCK. Roughly speaking, the major competition to IBM has been the seven companies listed on table 2 who have 2 to 10 percent of the market apiece. The seven were reduced to five with the Honeywell-General Electric merger in 1970 and the exit of RCA in 1971.

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*See p. 4836.

Besides the companies listed, there are a large number of companies with under 1 percent of the market each, largely competing in specialty areas such as minicomputers rather than the main general-purpose computer market.

Barriers to entry are anything which makes it difficult or impossible for a new firm to enter the industry. For the computer industry, barriers to entry consist primarily of raising capital, economies of scale, and brand loyalty. All three problems are much greater in the integrated systems portion of the market than in individual parts of the computer market, such as software companies or companies which make only input-output equipment.

Economies of scale are of minor importance in the actual manufacturing stage, but pose a significant barrier to new competition when considering production of software. Producing software is like writing a book. The first copy is very expensive, but subsequent copies have a low marginal cost.

A very small, well-managed firm would experience only slightly higher unit costs than IBM when producing tape drives, memory units, or central processing units, but would have an extreme cost disadvantage if it tried to compete with IBM's systems software, because almost all the cost is in producing the first copy.

Although applications software has the same theoretical economies of scale as systems software, in practice they are not so significant because modifications are often required for each user of application software.

Consequently, economies of scale have not been a significant barrier to new competition for companies producing competitive input-output equipment, minicomputers, and service and consulting organizations. Economies of scale have increased the difficulty of entering the integrated business systems market where complex and extensive software support is required for success.

The second barrier to entry—brand loyalty—is accounted for by two factors. The first is the difficulty of making rational computer selections. Because the major manufacturers are integrated, and parts of one manufacturer's system generally cannot be used in another manufacturer's system, the computer user must choose between complete systems, including the central processor, various kinds of input-output equipment, systems software, and various levels of consulting help and applications programs.

It will seldom be true that one system dominates the others on all possible points. Generally, the user will have to balance, say, a better operating system on one machine against better input-output equipment on another.

To complicate matters further, the user generally expects various enhancements over the life of the machine, either in software or hardware, which are not known in detail at the time of the selection.

The user also is often dependent upon the manufacturer for help in defining his computing requirements and choosing the proper equipment to meet them.

As a result of all these factors, the decision of which computer to purchase is seldom a perfectly rational one, but instead it is heavily dependent upon the user's judgment about the future actions of the various manufacturers. Equally qualified managers faced with the

same information are likely to come to different decisions about which computer best meets their needs.

As in any situation where clear choices are difficult, the established manufacturers with good reputations have a great advantage over new companies, even if the new companies have equal or superior products on an objective scale.

The second factor accounting for brand loyalty is the lack of compatibility among systems. In an extreme case, if all programs were written in assembly language and the two computers had different instruction sets, it would probably not be profitable to switch, regardless of the price of the new computer, because the cost of transferring all the programs would be equal to the value of the machine.

In the more normal case, with most programs in a language such as COBOL or Fortran, the basic programs are usuable but some changes are required either in the programs themselves or the job control language. Switching computers is conceivable in this situation, but the new company must offer substantial price discounts in order to induce the customer to pay the cost of conversion.

The compatibility and evaluation problems are largely the result of selecting complete systems and the incompatibility of various manufacturers' specifications.

However, when both of these problems are eliminated, some residual brand loyalty remains. Probably the most straight-forward decisions regarding computer equipment are those made between IBM and competitive, plug compatible, peripheral equipment.

Only a single piece of equipment is considered at a time, so systems tradeoffs are not involved, and the competitors adopt IBM specifications so that compatibility is not an issue. The only uncertain issue is the reliability of competitive claims for their product versus those of IBM.

Even in this simplified situation an IBM study showed considerable brand loyalty. IBM asked a sample of its disk customers what the maximum discount was that a competitor could offer for a replacement product and the customer still remain with IBM. The results are shown in table 3.

As can be seen from the table, only a small proportion of IBM customers were potential targets at discounts of less than 10 percent, and 31 percent would remain with IBM even with discounts over 20 percent. If the table is an accurate representation of the computer marketplace, brand loyalty is a substantial barrier to entry even in the plug-compatible peripheral market.

The quantity of capital required for entry into the computer industry depends heavily upon the segment entered. Service bureaus, consulting groups, and software houses can have very low capital requirements of a few thousand dollars for initial salaries and office rental before payments begin.

Plug-compatible peripherals and minicomputers have capital requirements beyond the ordinary range of private financing, but still moderate in comparison with many industries. In minicomputers, the most successful new entry in recent years, Data General, began with \$50,000 in 1968, but raised \$20 million more in the stock market between 1969 and 1971 to become an established company.

In analyzing potential entry into the memory business, IBM estimated that a new company could begin with \$75,000, but would need

to invest $15 to $20 million more over a 4- to 6-year period before reaching the break-even point.

The capital requirements for entry in the integrated systems business are huge. When RCA left the computer market in September 1971 it took a $490 million writeoff. In addition, the company estimated it would have needed a $500 to $700 million new investment over the next 5 years in order to attain profitability, suggesting total capital requirements of over $1 billion for a competitive systems company.

The amount of capital required is so large that it is unlikely that any new company could raise it, and it is beyond the financing capabilities of all but the largest corporations.

In speaking of capital costs as a barrier to entry, I would like to respond to Mr. Granfield's remark yesterday to Mr. Collins that firms have no difficulty raising any amount of capital if they are earning a normal return. So long as there is perfect certainty with regard to future earnings the statement is correct. If the amount of risk is well defined and agreed upon by all investors then the cost of capital is still independent of the quantity needed. However, an investment in a new company is not only risky in the sense that there is some variance around the expected return, but also uncertain in the sense that the mean and variance of the return is unknown.

Each investor has a different subjective probability distribution regarding the return and risk he expects on the investment. If only small amounts of capital are needed, it can be raised from those investors with the most favorable outlook. As larger amounts are needed, successively less favorable investors must be tapped, causing an upward-sloping supply curve of capital to the firm rather than a perfectly elastic one; consequently, the absolute amount of capital required does form a barrier to entry.

Taken together, the capital cost, brand loyalty, and economies of scale form an almost insurmountable barrier to new entry in the integrated systems business. In spite of tremendous market growth and extensive technological changes no new companies have successfully entered the integrated systems business since 1960.

In contrast, there has been continuous entry in peripherals, software, and minicomputer companies, as would be expected from their very low barriers to entry.

The extensive brand loyalty in the computer industry means that all major manufacturers—not only IBM—have market power. Market power is defined as the ability to raise prices above the cost of production, including a normal return to capital, without being driven out of the market.

If no manufacturer makes a specific attempt to attack the customer base of another manufacturer through compatibility and/or conversion aids, then all can enjoy high profits and stable market shares. This has not been the pattern observed so far in the computer industry, but appears to be becoming more important.

So long as growth in the industry was extremely rapid and the non-IBM manufacturers had a relatively small customer rental base, it was to their advantage to aggressively attempt to expand their market share.

However, price competition is very expensive to companies with large rental bases because a price cut means not only lower revenues on the new customers attracted, but also lower revenues on machines

placed earlier. Consequently, there is a tendency to concentrate more on upgrading one's own customers than on taking customers away from competitors as the rental base grows larger.

IBM's evaluation of competitors for the 370-135 concluded:

It appeared that many competitors were focusing on protecting and growing their own inventory bases and were not prepared in the near term to get around the M135 in pursuit of IBM's lease base.

IBM has been the best example of the grow-your-customers approach to computer marketing, but not the only one. IBM has made a strong effort to develop close relationships with its customers through emphasizing rental rather than sales, and before 1970 by emphasizing a full range of services in addition to the hardware for the basic price. IBM does not provide conversion aids from competitive machines and makes no attempt to directly undercut any given systems manufacturer.

Because of the high cost of switching between incompatible machines a firm that wants to expand its share of the market cannot simply cut the price of its machines. It must either provide a lower price, together with compatibility, or provide a technological advance which increases the capability of the machine.

Both strategies have been used regularly in the industry.

If a substantial increase in the capability of a computer can be made through technical innovation the innovating company can attract new customers who either are not using computers or who need the new capability enough to pay the necessary conversion cost.

Two examples are the Control Data 6600 and the Burroughs master control program. When the Control Data 6600 was delivered in 1964, its capacity was far beyond anything else on the market. Consequently, for very large-scale computing needs, such as atomic energy research, the 6600 could easily induce the user to switch from previous computers even without compatibility.

Burroughs' master control program for the B-5000 system and related AOSP system for the military-oriented D-825 system put Burroughs well ahead of other companies in developing effective multiprocessing capability which increases reliability.

Burroughs' early development of multiprocessing and virtual memory capability allowed the company to attract customers needing those capabilities, in spite of compatibility problems.

The innovation approach to increasing market share is only successful if the innovation is accomplished successfully without too great cost to the company, and if it cannot be easily duplicated by competitors.

Transistor computers were probably the greatest single advance in the industry so far. Philco was the first company to introduce a large-scale transistor computer, but was followed so closely by the IBM 7090 that Philco gained little advantage in its innovation.

Time sharing has been a very important development since the mid-1960's. However, General Electric made early large investments in time-sharing technology, but failed to capitalize on its innovations because the costs and technical difficulties were greater than expected.

The third possible strategy is to market directly against a particular computer manufacturer through copying design specifications in order to achieve a high degree of compatibility. This is the most di-

rect method of expanding market share, and also the most dangerous for the firm because it is equivalent to starting a price war. Once compatibility is achieved customers can more easily leave the aggressive company as well as come to it. The price cutting company must be concerned both with competitive response and the timing of its attack in the product cycle.

• If the competitive product is introduced late in the target firm's product cycle, it must also be competitive with the target firm's next generation or the rental life will be too short for profitability.

The target firm may choose to cut prices as a result of the competition, but it must be concerned for the effect on its own rental base. If only a small proportion of the rental machines are likely to move to the competition, then the firm would be hurting itself with an across-the-board price cut to restrain competition.

Two of the best examples of the compatibility strategy are the Honeywell H–200 and the RCA Spectra 70 series. During the early 1960's the IBM 1401 was the most popular computer on the market. Honeywell announced the H–200 in December 1963 for first delivery in July 1964, together with a program called the Liberator, which would convert the IBM 1400 series programs into H-200 programs. The H–200 was a great improvement over the 1400 series, for comparable prices, and strong enough to remain competitive with IBM's replacement for the 1401, the 360–30.

The success of the H–200 was increased by incompatibility between the 1401 and 360–30, making it easier for a customer to convert to Honeywell than to upgrade to IBM. The H–200 success brought Honeywell into an early position of stability and profitability in the computer industry.

A less successful example of the compatibility strategy was the RCA Spectra 70 series. Soon after the IBM 360 was announced in 1964, RCA announced the Spectra 70, a series of four computers, each designed to be compatible with, but to outperform, its 360 counterpart. The instructions format, and character codes were identical to those on the 360. In spite of compatibility, the Spectra series did not sell well against the 360. RCA was trying to sell against a largely undefined, rapidly changing target as various enhancements were added to the hardware and software of the system 360, making close comparisons difficult for customers to make.

In addition, RCA could not offer the same kind of clear price advantage that Honeywell did against the 1401 because RCA was bringing out its machines at approximately the same time as IBM, while Honeywell had the advantage of several years additional technical development. RCA's market share remained at the 2.5- to 3.5-percent level of its pre-Spectra days.

The difficulties in following a competitive strategy with the current structure of the computer industry make the profits to be earned from competition questionable and far in the future. So long as the company is consciously undercutting other prices or investing large amounts of money in new technology, it is unlikely to be making substantial profits. It is buying market share for future profits.

However, there is always the risk, as happended with RCA and GE, that the future profits will never be realized. If no firm makes specific compatibility attempts each can act in a semimonopolistic

manner with a good deal of market protection. Competition and general technological progress cannot be ignored because if prices are too high other firms will come into the market or customers will switch and pay the conversion costs, but the entire market would be relatively insensitive to exact price comparisons.

If no firms made definite attacks on each other's customers through compatibility and lower prices the industry as a whole would reach its maximum profit position. This would also be the worst position for customer welfare. It appears that the industry is moving in this direction since the exit of RCA.

In this respect, I think it might be relevant to comment on Mr. Granfield's questions to Mr. Miller this morning regarding homogeneity of return among the various companies in the industry.

If all companies were following a strategy of simply growing their own customers, then we would expect to see relatively homogeneous profits. However, so long as some companies are making a specific attempt to increase their market share their profits will show up as lower during those years. I believe that is what has been happening throughout most of the history of the computer industry. Honeywell, RCA, GE, and others have been making a direct attempt to increase their market shares and consequently have been making lower profits than you would have expected if they were not making that attempt.

While full systems suppliers have three strategies open to them, partial line suppliers have only the compatibility option available. Because they are competing for one product on another manufacturer's system their products can be made obsolete by a change in the systems makers specifications, leaving them without a stable base of customers. Technical advances are limited by the need for compatibility with the systems maker's equipment.

The partial line suppliers are made dependent on the systems supplier because of the lack of independent CPU suppliers.

Consequently, at present the customer cannot purchase an entire system without using the CPU supplied by one of the systems manufacturers.

An example of the benefit that can come from having independently available CPU's can be seen in the current market for used system 360's. Because leasing companies bought large numbers of 360's during the late 1960's, many are available for remarketing and modification. The purchased 360 CPU's have been improved with independent memory, input-output devices, and in some cases enhancements to the operating systems in order to make them far superior machines to what was allowed by IBM specifications.

However, the significance of this movement is limited by the numbers of purchased 360's available for modification, because no independent company is manufacturing CPU's.

The problems of the independent peripheral companies in competing with IBM are documented in the selection from my forthcoming book, which has been presented as a written supplement to this testimony, as well as by several of the other witnesses at these hearings.

[See exhibit 2.]

Mr. Brock. Here I will summarize the economic issues involved in the controversy between the peripherals companies and IBM. The basic fact necessary to understanding the problem is that there are

high barriers to entry in the systems market but low barriers to entry in the peripherals market. In any situation where a company possesses substantial market power in one product and less market power in a complementary product, the most profitable policy is to tie the products together, refusing to sell one without the other. If the products are totally tied together the company can choose the prices for each combination to optimize profit, without concern for competition. However, because of legal restraints on tying products the company may want to raise the prices on the product with monopoly power and reduce the prices on the product subject to competition as a substitute for tying them together. This is not as profitable as tying the product together, but it is less likely to get the company into legal difficulties.

IBM has pursued a combination of both strategies in response to peripherals competition. IBM has tied products together where the tie could be technically justified, and has raised the CPU prices while reducing peripherals prices where tying could not be defended on technical grounds.

Examples of tying products together are the integration of controllers with the CPU on the 370–145 and later machines, and the tying of large quantities of minimum memory to the basic CPU price on the 370–158 and 168. Although it cannot be established for certain that the integration was a response to competitive pressure, rather than simply a design change to take advantage of new technology, the circumstances surrounding the introduction of integration suggest that it was in response to competitive pressure.

Examples of raising the CPU price while lowering the peripherals price in response to competitive pressure were the fixed term plan, which reduced the price of peripherals, followed by a general CPU price increase and the reintroduction of the 370–155 and 165 as the 370–158 and 168 with a 36 to 54 percent increase in CPU price, and a 57 percent cut in memory price. Such price manipulations would not be possible if as much competition existed in CPU production as in peripherals, or if the CPU's were made by a separate company from the peripherals.

The ability of IBM to shift price between peripherals and CPU's reduces the beneficial effects to customers of competition in peripherals, as well as threatening the existence of the independent peripherals companies.

A second aspect of market structure which accounts for actions in the peripheral market is the disruption caused by equipment installation and removal, even when compatibility is not a problem. This means that extra revenue can be obtained when a price cut is necessary by requiring an equipment exchange to take advantage of the price cut. This tactic was used effectively with both the 2314 disk drive and the 2420–7 tape drive. In both cases IBM needed to make price cuts in order to remain competitive. In both cases the price-cut products were introduced as new products with identical performance specifications, the 2314 as the 2319 and the 2420–7 as the 3420–7. The price was reduced 31 percent on the 2319 and 34 percent on the 3420–7. The customer could only get the price cut by physically removing the old product and installing the new one. The freight charges and disruption involved, as well as the lack of information or lethargy on the part of some computer managers, allowed IBM to have a competitive low

priced product while still receiving the higher rent from many customers for some time after the price cut.

The third structural characteristic that accounts for the actions of IBM toward the plug compatible manufacturers is the necessary time lag between IBM introduction of a product and competitive copying of it in order to insure compatibility with constantly changing IBM systems specifications. In the early days of peripheral competition IBM overestimated this lag and erroneously felt that it would make the plug compatible competition a minimal threat.

Later IBM introduced the fixed term plan and more rapid minor product changes in order to capitalize on the time lag. When a new product is introduced customers have little incentive not to accept it on the fixed term plan because no competitive replacement was ready. The heavy penalties for early termination under the fixed term plan effectively reduced the competitors' prospects to those customers finishing a lease. By making rapid minor product changes, such as switching control functions between drives and control units, IBM was able to further reduce the plug compatible manufacturer's marketing effectiveness without reducing prices.

The foregoing analysis is not meant to suggest that there was anything wrong with IBM reducing prices. Prices of peripherals before the competitive companies entered the market were much higher than necessary to give a normal return to capital. The proper functioning of a competitive market, as well as technological progress, should and did force the prices of peripherals down.

The problem is that customers did not get all the benefit of the lower prices. Some of the savings from the peripherals was merely transformed into a higher price for the CPU. The beneficial effects of competition in peripherals were thwarted by the monopoly power in the production of CPU's.

In considering possible methods of improving the performance of the computer industry it is necessary to concentrate on removing the factors which have lead to the current problems.

Because of the brand loyalty which arises from integrated systems production, splitting IBM into several smaller integrated systems manufacturers would be unlikely to completely solve the problem. The greatest current competitive emphasis in the industry has been from the independent peripherals makers, not the smaller systems suppliers. Although the industry would be more competitive with less dominance by one firm, it would not be likely to reach the best possible performance. A better solution is to split IBM by functions; to make separate companies out of the production of CPU's, peripherals, maintenance, and marketing functions. This would prevent monopoly power in one segment from being spread into the other segments.

There would continue to be barriers to entry to the CPU business because of the economies of scale in the production of systems software, but that market power could not be enhanced by control over a wide variety of other activities.

If such a split were made each segment of IBM would have to compete on a fair basis with other companies. If IBM were really more efficient it would continue to dominate. However, it could not use power in one area to manipulate standards or price ratios in order to fight competitors in another area.

Neither could one activity subsidize another because they would be separate companies.

The proposed type of organization already exists to some extent in the minicomputer market, and appears to be very effective. Minicomputers are generally sold as distinct components: CPU, software, peripherals, et cetera. Although the major manufacturers of minicomputers do provide complete systems, it is also common for systems to be made up of several manufacturer's components.

Specialized companies have been formed to choose the appropriate minicomputer systems components, write software, and deliver complete packages to customers. A wide selection of peripherals is offered by many different manufacturers with interfaces for a variety of minicomputers, rather than for only one manufacturer's product as in the main systems industry.

The British National Computing Centre is developing a common assembly language for a substantial number of minicomputers in order to provide total program compatibility. Entry into all phases of the minicomputer business has been easy, prices have dropped rapidly, and the entire industry has been much more competitive than the main systems industry, in spite of relatively heavy concentration.

Consequently, it appears that the lack of competitiveness in the main computer industry is a result of integrated systems selling rather than concentration in itself.

Senator HART. Thank you very much. You are a fast reader. I know staff has some questions.

Mr. O'LEARY. Your proposed remedy contemplates keeping IBM facilities for the production of CPU's and the development of systems sofeware in one company, but what about software?

Dr. BROCK. I proposed in the remedy that I wrote for the subcommittee that the application software go with the marketing company. Let me explain the reasoning behind that. I see right now a substantial benefit to the user in being able to buy a totally integrated package that will include rental on a system, consulting help, and installation support, all the kinds of things that IBM currently provides.

However, it is not necessary that that same organization also do the manufacturing. By keeping the application software with the marketing company you wouldn't be breaking up any of the natural economies that come to the user.

It is largely a matter of avoiding user disruption, from having to deal with too many different people.

Mr. O'LEARY. In that regard, Mr. Chairman, I think the record should reflect that Dr. Brock was a consultant for the subcommittee and prepared a paper for the subcommittee which should be submitted for the record.

Senator HART. It will be received.

[The document referred to appears as exhibit 3 at the end of Dr. Brock's oral testimony.]

Mr. O'LEARY. Doctor, with respect to this company which produces CPU's and developed systems software, how long would they be barred from integrating into, say, application software, peripheral equipment, and the like?

Dr. BROCK. I think that that is a subject that requires more study. My current idea would be that they probably would not be barred at

all. Or if at all, for a short period of time—say 2 years—in order to make sure that they actually operated as a viable business and didn't just go out and remerge.

But the idea behind my reorganization proposal was, as I think most of the other people here have indicated, to eliminate continuing regulation so that it is largely a one-time thing. I can see a possible need for a short bar, just until you get things established on the new level.

Mr. O'Leary. What about the production of components?

Dr. Brock. I believe that if you have the production of CPU's separated from the marketing function, there is probably a necessity to keep the production of components with the production of CPU's. The reason for that is simply the technological advances that are going on.

We have seen over the past few years a rapid increase in the scale of integration of components; that is, the number of circuits put on a single silicon chip. And since the CPU company would only be manufacturing CPU's, I can imagine that it is very likely that in the future much of the design of the CPU will actually be contained within the component.

We, to some extent, can see that already with companies such as Intel, which market what they call a microcomputer, which is effectively all contained in one chip.

And, if things like that should continue, and it appears that they will, there would be very little difference between designing a CPU and designing a component.

Mr. O'Leary. I assume that your plan involves some sort of agreement and publication of standards to insure capability. Am I right or wrong in that regard?

Dr. Brock. You are right that it assumes that. I believe that this plan would force the various manufacturers to agree on standards voluntarily.

One of our current problems in standards is that, and I am sure you know, the American Standards Organization works on a voluntary basis, and almost all product standards that have been developed are done voluntarily by consensus agreement of the various manufacturers involved.

That works fine so long as the manufacturers see it as being within their own interests to have standards. Our current difficulty is that IBM really does not see it within their own interest. This is not a criticism of IBM. It just simply is not within their interest to have generally accepted standards.

If you have the functions separated it would be within the interest of all the companies to have standards because the standards would increase the market for their different products. It will be of no benefit to the new peripheral company to have a lot of peripherals if there is not some CPU that they can attach to.

Mr. O'Leary. Isn't there always a little bit of concern on the part of someone who believes in antitrust. They get the idea that competitors can sit down and decide what the standards will be and what the effect of that is on new technology?

Dr. Brock. You mean that it would be kind of a collusive agreement on the standards?

Mr. O'Leary. Do you see some problems there?

Dr. Brock. Well, I think that there are potential problems there, but I really think they are largely taken care of by the current standards organization procedures. That is, where you have everything done above board, and the committees get together and publish all the results, and so forth, and different manufacturers have the ability to comment on them.

If you were to say, "Well, let these four companies. get together and produce the standards." That would be a serious problem.

But if it is handled through the American Standards Organization, even if it has a committee of the manufacturers working on it, I wouldn't expect the problem, but it is a potential difficulty.

Mr. O'Leary. How did the type of structure that you described in the minicomputer industry come to be? Was it simply the absence of a firm such as IBM which permitted this development, or what?

Dr. Brock. Yes. It was the absence of a firm such as IBM. I think that it was largely from the history of the minicomputer market, in the same way that we see the current structure of the general purpose computer market growing out of the tabulating machine market. Minicomputers started out as very specialized machines, usually for industrial process control. So that rather than have a general operating system and general software you had a specific problem, and they were really treated as special purpose machines.

The marketing question faced was of the form:

"Can you build me a program that will control this operation in my oil refinery?"

However, the minicomputer could also be programed to perform additional tasks. Digital equipment has lead the development of minicomputers.

It started out marketing its machines on a sale-only basis. This was partly because it was a new company and had little capital available for financing and partly because a sales policy seemed very natural in the type of market Digital was participating in.

Digital would usually sell the machines in parts; that is, you could buy just the CPU without any systems software, or anything else, and put the system together yourself. I think the current structure of the minicomputer industry comes from its development as a specialized machine.

Mr. O'Leary. The suggestion has been made that competition in the industry would be improved if a GMAC type entity were created for financing of the leasing of all computer systems manufactured. How do you react to that idea?

Dr. Brock. In the sense that a leasing company can very logically operate separate from a manufacturing company, I certainly agree with it. If you mean would we have to, in some way by public policy, try to get all computer leasing functions together in a single leasing company, I can see no benefit in that.

We now have very effective leasing companies in a strong leasing industry, which also has expanded into certain amounts of application and consulting help.

So long as the computers are available for sale on reasonable terms I think we will see from the normal actions of the marketplace a substantial and useful leasing industry.

Mr. O'Leary. Thank you Mr. Chairman.

Senator HART. Mr. Chumbris.

Mr. CHUMBRIS. Thank you Mr. Chairman. Dr. Brock, I find certain things in your paper that, because of legislative policy, there is a conflict of opinions. So, rather than getting into a debate with you, I just wanted to note for the record, when we have an executive session that it will be up to the Senators to determine whether your recommendations are appropriate or inappropriate for the public good. I think, Dr. Granfield has some questions.

Mr. GRANFIELD. I welcome fellow economists, and I am sure, as all economists, we don't necessarily agree either because we don't understand each other or because we see the world differently.

But, I think we would agree, as will everyone, we receive greater efficiency with lower prices as our ultimate goal. With the premise, Dr. Brock, are you, or your thesis adviser, who I have been led to believe is Dr. Houthakker at Harvard——

Dr. BROCK. Absolutely wrong.

Mr. GRANFIELD. Wrong?

Dr. BROCK. That is what I would suspect was the reference from Mr. Katzenbach's statement that I completed a thesis under one of the Government's advisers; Professor Houthakker is a Harvard professor. I have had no direct contact with him. I have not even taken a course from him. The only relation that I have had with him in a formal sense is that he examined me on macroeconomic theory at one time, and wage price controls.

Mr. GRANFIELD. Who was your thesis doctorate?

Dr. BROCK. As I said at the beginning of the statement, Professors Richard Caves and Marc Roberts.

Mr. GRANFIELD. Are either of these gentlemen going to be involved as witnesses in the Government's case; either you, Professor Caves, or your other codoctorate.

Dr. BROCK. None of us is scheduled to be witnesses at this time.

Mr. GRANFIELD. Thank you. I feel somewhat freer to pursue some of my questions.

You list various entries in the computer industry. Let us assume you and I decided to go into the raising of racing thoroughbreds, and to acquire capital to do so we go to bankers and present the argument that because we are economists we know all about efficiency and we are going to build a better horse. Do you think that we would be granted a loan at the same rates as farmers?

Dr. BROCK. I doubt that we would be granted a loan at all.

Mr. GRANFIELD. Let us assume we would be granted a loan. Do you think it would be a higher rate of interest or lower?

Dr. BROCK. If some banker would be foolish enough to grant me a loan for racing horses it would be a higher interest rate, I would presume—although I wouldn't necessarily comment on such a banker's analysis. It might be lower.

Mr. GRANFIELD. Assuming it is higher. Why is it, do you believe, the rate that we would be made to pay would be higher than the farmer would be made to pay?

Dr. BROCK. Presumably, and the reason why I think we would be turned down, is that they would not believe that we would be successful in the business?

Mr. GRANFIELD. Too risky?

Dr. BROCK. That we don't—I'll speak for myself, I don't know about you now—that I would not have the managerial capabilities to raise horses.

Mr. GRANFIELD. Isn't that a barrier entry to our entering the thoroughbred industry. No one will give us money. That is awful.

It is an obvious barrier to entry. It is discrimination.

Dr. BROCK. I will certainly agree to call that a barrier entry. I don't think that has any great significance. The things in economics that we try to examine are those that differ across industries. And one of the things that is constant across any industry in any business is that you must know something about the business in order to go into it. The fact that you actually have to sell a product is also a barrier to entry. But I don't think that has any relevance to economic analysis.

Mr. GRANFIELD. You indicated in your analysis that there were capital barriers to entry into the computer industry.

Dr. BROCK. Yes.

Mr. GRANFIELD. Is there a capital barrier to entry for General Motors to enter the computer industry?

Dr. BROCK. I would say there is some barrier to entry in this sense: They presumably can raise the capital and go into it, but because of the very large quantity of capital required in relationship to their own capital base, they might at least think twice about entering it, or be reluctant to because of the risk involved.

Mr. GRANFIELD. So it is the risk. Is it riskiness that is a barrier, or is there some wall that is there?

Dr. BROCK. I think that you are trying to trap me, but——

Mr. GRANFIELD. I would never want to do that. I only wanted to bring out what exactly a barrier to entry is, because if there is a wall there to prevent people from entering the computer industry——

Dr. BROCK. Let me explain what I mean by a barrier to entry. I mean anything that raises the cost for a new company above the cost for an established company. Now, it may not be true that there are some barriers to entry that are insurmountable barriers to entry. If IBM really has a production cost 10 percent lower than anybody else, from greater technical efficiency, I would call that a barrier to entry. It is a 10 percent barrier to entry in terms of the amount that IBM could hold the price above the competitive profit level and still not have entry.

But that doesn't mean that there is a wall, it is—you might say—a hurdle of different heights for different people. Some barriers to entry may only be a very low hurdle and some may practically be a wall.

Does that explain more clearly?

Mr. GRANFIELD. That explains the point very well. But is it not true for any new entrants to industry that they will probably face that kind of barrier? Is it somewhat of a disadvantage? When you go into a new industry, is there always a barrier?

Dr. BROCK. Yes; the thing that is important for economic analysis is to determine the height of that barrier. In terms of the things that we are talking about here, I would say yes; there is some barrier to entering the minicomputer market. You have to get a little bit of capital together, you have to have the technical expertise to make machines, and in fact some people might call that a fairly significant thing to get enough technical people together to compete with Digital

Equipment, Data General, and other very highly qualified companies.

And yet that is a very low barrier to entry relative to the general systems market where you have to do a lot more. So that I am talking about relative height: It is not something that where you say there is no barrier here and there is an insurmountable barrier here. It is different levels of barriers.

Mr. GRANFIELD. What creates the height of that; what is a critical factor?

Dr. BROCK. Well, they all work together, but the most critical factor—and I think I would be in agreement with most of the other witnesses that have spoken at these hearings—is the product differentiation.

In particular, it is the difficulty of switching among computer systems. Because you have programs, data, operating procedures, job control cards, and so forth, that are to one degree or another specialized to your particular system, you must see more than the economist's infinitesimal price difference in order to move over to another supplier.

Now that is not an insurmountable barrier, unless you happen to have everything in machine language. In many cases if you orient yourself toward compatibility—that is, you write your programs in COBAL and Fortran, and use ASCII coding on your data, and so forth—it may only require a 10- to 15-percent advantage.

But that would be, I think, the very lowest price differential that anyone would really even seriously consider moving for.

Mr. GRANFIELD. Could I turn to the transfer cost.

Dr. BROCK. Yes. Well, you could. It depends upon what you mean by transfer cost.

Mr. GRANFIELD. Transfer of one system to the other.

Dr. BROCK. Yes; it is a cost of changing systems.

Mr. GRANFIELD. Is that transfer cost for all current members within the industry when they approach customers without part of a system.

Dr. BROCK. It exists for all current integrated systems manufacturers. Again, there are very different transfer costs. If I have an IBM 2314 on my 360–30 and you come to me with a plug compatible 2314 and ask me to switch to your machine. I have a very low transfer cost for that. I only have to unplug IBM's 2314 and put yours in. It is much different if you ask me to replace my entire system with another brand because I will have to change my programs, operating systems, and so forth.

Mr. GRANFIELD. How could transfer cost be a barrier to entry to firms already in the industry—if barrier to entry means barrier to entry of any industry.

Dr. BROCK. I don't understand your question.

Mr. GRANFIELD How could transfer costs be a barrier to entry to a firm that is already in that industry. How can that be a factor generically affecting anybody? Is that a barrier to entry?

Dr. BROCK. You could quibble over it on semantic grounds. What I mean by these barriers to entry are difficulties either for a new firm coming into the industry or for old firms gaining new market share, which I consider entry in a sense.

So that the fact that Honeywell has difficulty gaining IBM customers, or that IBM has difficulty gaining Honeywell customers, is related to the same problem.

Now, whether you want to call it a barrier to entry or not is strictly a matter of semantics. I don't think it affects the reality there.

Mr. GRANFIELD. I really thought that the use of a methodology of barriers to entry was one which was used to explain why we didn't see new entrants into an industry. For example, when people say, "Why don't we see new entries into the soap industry," what are the factors we have; what is relative here? The basic thing is brand loyalty with respect to soap. But that loyalty doesn't affect the already alleged firms. Do you understand? If you don't understand we can move on.

Dr. BROCK. Well, I think maybe we can move on. But, let me just say the brand loyalty, or the difficulty of switching, is a barrier to entry to new firms. And I agree that is the normal way of using it.

And you can call this a barrier to entry or not, depending on what you want, but it also makes it difficult to switch computers among existing firms. So that it is difficult for a Honeywell or a RCA to increase their market share, as well as other new firms coming into the market.

Mr. GRANFIELD. I have seen a commercial recently where a lady is offered a can of deordorant, brand *x*. She is offered a carload if she will switch deodorants to this other product, Superstick or something. And she says she won't switch. Is that brand loyalty?

Dr. BROCK. Yes; I would say so.

Mr. GRANFIELD. Is that the kind of brand loyalty professed to customers of Honeywell?

Dr. BROCK. No. In one sense it is, but Honeywell's brand loyalty is much stronger. The brand loyalty that we see in most consumer products, and is traditionally associated with deodorants, soap, and other things like that, is because you know that product. You often don't have an absolutely determined utility function on exactly what the product is, but you think it is good for you. So there is a fuzziness there as to exactly what you are getting. So you are not willing to switch to something else.

Now the parallel to that in the computer industry is the difficulty of measuring exact computer power. That is, you give me two different computer systems and say without reference to a single program, which one is better. If one is very much greater than the other, I can tell you it is clearly better. But if they are relatively close, the kinds of systems you would be considering in a competitive situation, I can't tell you that without bringing in a specific program and trying it out on them.

The measurement difficulty causes brand loyalty both in consumer products and in the computer industry.

The second aspect, which is not there in consumer products but is there in the computer industry, is the difficulty of switching. There is no cost to me of trying our brand *x* deodorant. But, when I go to switch complete computer systems, I actually incur a real financial cost.

Mr. GRANFIELD. I think that is an excellent distinction you make. One is based upon loyalty to the product because of proven services given to you, and you may be reluctant to change products because you are not quite sure whether the other product will give that same reliable level of service.

The other point you mentioned is simply the technical costs. How do we possibly determine which is operating and to what extent in this particular market? How do we know customers don't switch from IBM, or from Honeywell once they had Honeywell, because of the tremendous risk involved in using another system versus the technical cost of switching? How can we possibly sort out these two very common complex questions so that we can make the statement that the problem in the industry is system lock in; the technical transfer cost of the problem rather than the customer's risk aversion to changing systems? How can we possibly do that?

Dr. BROCK. Let me answer that in two parts. First, I am not sure that we have to, because I see both of those issues coming from the same problem of integrating systems selling. If you didn't have integrated systems it would be much easier to judge exactly what the system is doing for you. That is, no one has ever been able to determine the relative advantages of a Telex 5314 disk drive—I think they call it the 5314—and an IBM 2314 disk drive, because they are designed to perform exactly the same thing and they are very similar products.

Now the second part, assuming you don't believe that we don't have to determine the costs separately. I think that you can determine the relative effects of measurement difficulties and transfer costs by analysis with the users. This is the kind of decision that computer users are faced with all the time. They are always faced with making a selection among computers. And they have to go through and assign specific values to being a current system, or to the actual cost of the transfer, and so forth.

So that it is not an insurmountable problem; you can get around that.

Mr. GRANFIELD. I'm just saying that I have never seen any analysis of that. The risk involved to an EDP manager in changing a system, the greatest risk is something will happen to the new system that he feels incompetent to handle, and that is a tremendous risk because it could mean his job.

I think that is just an internal bureaucratic view. It seems to me I might not buy a system that may perform better rather than buy a system that breaks down. He can be absolutely reprimanded for that; but the sin of ommission to not buy the system that could perform better is one that he may never be called upon to answer for. That to me seems to be the greatest component of system lock in. It is not system lock, it is risk aversion on the part of the manager. The more complex the area the more risk aversion the manager will have.

Dr. BROCK. I would fully agree with most of what you said, except for the part of saying that that is the only thing that is relevant. I think that there are two parts to it. The uncertainty of exactly what is going to happen with the new product is definitely a problem. And that is why I would like to see the industry structured along the lines I have outlined, because it is much easier to know what is going to happen with the new product.

Mr. GRANFIELD. If this total systems approach is evolved seemingly because it is the most efficient way to sell that computer service, and there is one firm that seems to perform the total systems function more efficiently than the others, do you wish to change that so that we don't have that total system offering except by firms who seem to not offer

efficiently as IBM? Isn't that a strange recommendation for an economist?

Dr. BROCK. If I agreed with the two premises, then yes; it would be a strange recommendation. I don't accept the first two premises, that it is the most efficient method and that IBM is the most efficient company doing it.

Mr. GRANFIELD. You don't?

Dr. BROCK. No; I don't.

Mr. GRANFIELD. You don't feel that the industry is involved, that this is the most efficient way of handling their business?

Dr. BROCK. No, I don't say they necessarily lose efficiency in this. But, I think the reason for maintaining the entire systems market is in order to enhance product differentiation and market control rather than because it is more efficient.

Mr. GRANFIELD. How do we know that? That is speculation.

Dr. BROCK. In the sense that all economic analysis is speculation.

Mr. GRANFIELD. Well, to me economic analysis is evolution in action. It sorts out the less efficient ways toward more efficient ways because it punishes inefficiency.

Dr. BROCK. If you start with the assumption that all market structures are a result of efficiency sorting out the best structure, then obviously it is silly to talk of ever rearranging the market structure. That assumption is one that I don't accept, because I think that we have too much evidence to the contrary. There are things such as the IBM case and a number of other industries where there is evidence of direct market control of maintaining things that may not be directly inefficient, but you cannot say this current structure evolved in order to produce efficiency.

Let me offer a bit of evidence. Some of this evidence is more specifically documented in the chapter that I presented here.

Consider the question of computers. IBM found, at the time they introduced the systems 360, that it was efficient to put a controller between the channel and the peripheral device which would handle the electronics. This helped produce the standard interface on the channels so that you could put a number of different devices on it.

They found that to be efficient. That was done presumably for efficiency reasons.

Once the plug compatible companies found that this standard interface also helped them to replace IBM's products, then IBM started moving the controller inside. I think it would be absolutely wrong economic analysis to say they were doing that in order to gain more efficiency, when you can see it was clearly a response to the competitive attack on the product that was left exposed that way.

So that is the sort of thing I mean that is not totally without evidence.

Mr. GRANFIELD. In my reading of economic literature—and I am becoming very concerned about this use of the term monopoly—I have been led to believe that the way for a firm to achieve a monopoly is that what they try to do is monopolize one level of vertically integrated change of the industry. For example, the source of raw materials in aluminum. And they are very concerned that the rest of the community remain a competitor. Yet, you are telling us—I don't know whether you have used the term calling IBM a monopoly——

Dr. Brock. I don't believe I have.

Mr. Granfield. Well others have committed that they haven't done that. They are involved in vertically integrated parts of this business. This is the new theory of monopoly. A new theory by literally monopolizing the entire market, or at least attempting to. This is redundant. If you can monopolize one chain in the industry—it is redundant to work like hell to do it. It is counterproductive.

Dr. Brock. No; it is not really. IBM is a little more sophisticated in that. It is true that if you monopolize one level of the vertical production, then you can achieve a substantial amount of monopoly rent from that stage if the others are competitive.

But if you can also tie together several of those levels and monopolize all of them, you can sometimes achieve a certain amount of price discrimination that actually gives you more monopoly profits.

So, I don't see any reason why they would not want to monopolize all levels—if you want to use the word monopoly. I wouldn't apply monopoly to the industry, but that is what you are——

Mr. Granfield. I appreciate that. I wouldn't do that. One final question. At the beginning of your paper you go to great effort to establish your point of importance of various statutes. You talk about capital barriers, you talk about economies of scale, and finally you talk about brand loyalty, which I would correctly term as transfer cost, of which there are two elements.

One is the changing systems risk and the other is the technical cost.

But when you come down to your final conclusion you state:

> * * * Consequently, it appears that a lack of competitiveness in the main computer industry is a result of integrated systems selling rather than concentration in itself.

How does that apply to your barriers to entry argument?

Dr. Brock. I appreciate that question. What I meant by that statement is that the barriers to entry are caused by the integrated systems selling. And I tried to make that clear as I was going through what the barriers to entry are.

In other words, what I really meant to say at the end is that the problems in the industry are caused by barriers to entry rather than concentration. And that the barriers to entry are largely caused by integrated systems selling. You don't see that? I am glad to give a little more explanation here if you want it.

Mr. Granfield. Fine. Fine. I would appreciate it very much.

Dr. Brock. Let's take the problem first of what I term product differentiation and you called transfer cost.

As we said, there are two elements to it. We considered the first element the problem of the measurement difficulty—or what you call risk aversion. If the industry is broken up into individual functions—that is CPU's, peripheral products, maintenance and so forth—it is much easier to measure exactly what you are getting.

If I look at one disk drive from IBM and one from Telex and they do exactly the same thing but one is $10 cheaper, I know immediately which one to buy.

If I look at two complete systems and I find that one is better on its disk but worse on its tapes, and better on its operating system but worse on its applications software, and it is $10 cheaper, I don't know which one to buy.

But I can determine the best buy on each individual component. I can do the same thing with the CPU's as with disks, this is a better CPU or equal CPU and $10 cheaper, so I know which one to buy; this maintenance service, and so forth.

Consequently, eliminating integrated systems buying would make it much easier to measure exactly what you are getting. The problem of transfer costs would be eased by the standards that would come about naturally, I believe in the normal evolution of the marketplace. The standards necessary for using equipment of different manufacturers together would also improve the compatibility of programs and data with different systems.

So that is one barrier.

Now look at the second barrier, that of economies of scale. There would be relatively little change in that.

The third barrier is the capital cost. There would be a substantial improvement because it requires much less capital to enter any one segment of the market than all segments together. So long as there are major companies existing independently in each one of the segments, anyone who wants to enter any one of the segments can enter only that one segment and pay the capital cost of entering that segment, and not have to build an integrated systems business.

Right now, if you want to make a special kind of peripheral unit you must find someone else to supply the CPU to go with it because there is nobody making just CPU's So that is what I meant by barriers to entry that result from integrated systems selling.

Mr. GRANFIELD. I am sure we could go on forever with the barriers to entry, but let me finally conclude with the statement that I was delighted to see your concluding statement where you say the lack of competitiveness is not due to concentration in itself. I think that is a very fine conclusion. Thank you, Mr. Chairman.

Senator HART. Professor, thank you very much.

Dr. BROCK. Thank you.

Senator HART. I want to thank all who participated in this Senate hearing on computers. We will recess, to resume Tuesday at 10 o'clock in this room.

Mr. CHUMBRIS. May I just ask one question before we leave. I know we will be getting a lot of questions on when we may be resuming on IBM. Is there any indication from staff; 2 months, 3 months, 1 month?

Mr. O'LEARY. We just don't know at this time.

Mr. CHUMBRIS. Thank you. That is a good answer, and what I would like for the record so they won't bother us on the telephone from all over the country. Thank you very much.

Senator HART. Thank you.

[Whereupon, at 3:35 p.m. the Subcommittee adjourned, to reconvene Tuesday, July 30, 1974, at 10 a.m., in room 2228, Dirksen Senate Office Building, on the subject of the communications industry.]

[The following material was received for the record:]

MATERIAL RELATING TO THE TESTIMONY OF GERALD BROCK

Exhibit 1.—*Prepared Statement of Mr. Brock*

STATEMENT OF GERALD BROCK, ASSISTANT PROFESSOR OF ECONOMICS, UNIVERSITY OF ARIZONA

The computer industry occupies a unique position in the American economy because of its size and importance. In the last twenty years, computers have changed from a curiosity of use only in specialized scientific problems to an indispensible tool without which no large corporation, university, or government agency can survive. The computer industry is of special interest to academic economists such as myself because of its unusual market structure and rapid technological progress. I have been studying the industry for the past three years in an attempt to bring economic analysis into the debate surrounding potential government action toward the computer industry. My statement will concentrate on how the industry's price and product policies are related to the industry structure.

TABLE 1.—IBM MARKET SHARES

	Census	Honeywell	IBM interna
Year:			
1955		56.1	
1956	73.1	75.3	
1957		78.5	
1958	71.2	77.4	
1959		74.5	
1960	70.7	71.6	
1961		69.3	
1962	70.4	70.0	
1963	74.5	69.8	
1964	72.5	68.3	75.9
1965	66.7	65.3	74.8
1966	69.7	66.2	74.2
1967	74.3	68.1	74.3
1968	74.6		73.8
1969			71.0
1970	70.6		70.0
1971	67.4		
1972			
1973			

Source: Census figures from "Computers and Automation" and "Diebold Automatic Data Processing Newsletter". Honeywell figures from "Findings of Fact, Conclusions of Law and Order for Judgment", Honeywell vs. Sperry-Rand, 4-67 Civ. 138, district of Minnesota, p. 157. IBM Internal figures from "IBM Quarterly Product Line Assessment", November, 1968, p. 13 and March, 1971, p. 19, listed as planitiff's exhibits 123 and 127 in Telex vs. IBM, 72–C–18 and 72–C–89, northern district of Oklahoma.

By industry structure, I mean primarily the concentration of firms and barriers to new firms entering the market. IBM's market share, as computed by three different sources, is shown in Table 1. The first column, marked "Census", was computed from information on numbers of machines and average monthly rental given in Computers and Automation and Diebold Automatic Data Processing Newsletter. It is probably the least reliable of the three because of the secrecy attached to the figures by the manufacturers involved, and the resultant estimations used by the editors of the respective periodicals. The second column, marked "Honeywell," is taken from the Honeywell vs. Sperry Rand patent infringement case. The third column, marked "IBM internal," is taken from IBM's Quarterly Product Line Assessment and is the market share listed for "Systems and Peripherals." The three computations each have somewhat different bases and the figures do not exactly agree. However, they are close enough that we may conclude with confidence that IBM's market share has been in the 65–75% range. With less confidence we can conclude that IBM's share has been dropping slowly. The IBM internal figures show a steady drop from 1964 to 1970, the Honeywell decision figures show a cyclical movement around product generations with a slight downward trend, and the census figures show a cyclical movement around product generations with no downward trend.

Table 2 shows the market shares of the top seven non-IBM companies. The figures for 1955–1967 are taken from the Honeywell decision, while the figures for 1968–1971 are computed from the *Computers and Automation* censuses. Roughly speaking, the major competition to IBM has been the seven companies listed with two to ten per cent of the market apiece. The seven were reduced to five with the Honeywell-General Electric merger in 1970 and the exit of RCA in 1971. In recent years, Digital Equipment has expanded its offerings to the point where it should be considered a major competitor. Besides the companies listed, there are a large number of companies with under 1% of the market apiece, largely competing in specialty areas such as minicomputers rather than the main general purpose computer market.

TABLE 2.—MARKET SHARES TOP 7 NON-IBM COMPANIES

	Sperry-Rand	Honeywell	Control data	General Electric	Burroughs	NCR
Year:						
1955	38.5					0.3
1956	18.6				4.4	.1
1957	16.3	.3			3.9	.06
1958	16.3	1.0		.2	3.3	.04
1959	17.8	1.2		.9	4.2	.12
1960	16.2	.9	1.0	2.8	3.4	.4
1961	15.5	2.0	2.2	3.4	2.6	.7
1962	12.4	2.3	3.1	3.7	2.2	1.9
1963	11.2	1.8	4.0	3.5	2.6	2.7
1964	11.8	2.5	4.4	3.3	3.1	2.8
1965	12.1	3.8	5.4	3.3	3.6	2.9
1966	11.3	5.2	5.3	3.5	3.0	2.4
1967	10.6	4.7	4.7	3.0	2.9	2.5
1968	5.6	4.1	3.9	3.2	2.1	2.2
1969	3.2	4.8	7.3	3.1	3.4	2.3
1970	4.4	7.6	7.7		4.1	2.5

Source: 1955–67 figures from Honeywell v. Sperry-Rand Decision, p. 157. 1968–71 figures from "Computers and Automation".

As part of the discovery proceedings related to the IBM-Control Data antitrust suit, the Minnesota District Court authorized IBM to conduct a census of the computer industry. For purposes of the census, IBM defined the industry very broadly to include electronic switching systems, teletype machines, and applications software.(1)* Using IBM's definition of the market, American Telephone and Telegraph, which makes no general purpose computers, became the second largest "computer industry" participant. IBM computed its share of the market at 35.1% for 1970.(2) Economically, there is no single correct definition of the market, but it must include only those products which are in competition with each other. IBM's definition is so broad as to be meaningless for analyzing competition.

Barriers to entry are anything which makes it difficult or impossible for a new firm to enter the industry. For the computer industry, barriers to entry consist primarily of raising capital, economies of scale, and brand loyalty. All three problems are much greater in the integrated systems portion of the market than in individual parts of the computer market such as software companies, or companies which make only input-output equipment.

Economies of scale are of minor importance in the actual manufacturing stage, but pose a significant barrier to new competition when considering production of software. Producing software is like writing a book. The first copy is very expensive but subsequent copies have a low marginal cost. A very small well managed firm would experience only slightly higher unit costs than IBM when producing tape drives, memory units, or central processing units, but would have an extreme cost disadvantage if it tried to compete with IBM's systems software because almost all the cost is in producing the first copy. Although applications software has the same theoretical economics of scale as systems software, in practice they are not so significant because modifications are often required for each user of application software. Consequently, economies of scale have not been a significant barrier to new competition for companies producing competitive input-output equipment, minicomputers (which generally utilize relatively

*References may be found at the end of Mr. Brock's prepared statement. See p. 5664.

simple systems software), and service and consulting organizations. Economies of scale have increased the difficulty of entering the integrated business systems market where complex and extensive software support is required for success.

Two factors account for the very great brand loyalty found in the computer industry. The first is the difficulty of making rational computer selections. Because the major manufacturers are integrated, and parts of one manufacturer's system generally cannot be used with another manufacturer's system, the computer user must choose between complete systems, including the central processor, various kinds of input-output equipment, systems software, and various levels of consulting help and applications programs. It will seldom be true that one system dominates the others on all points.

Generally the user will have to balance, say, a better operating system on one machine against better input-output equipment on another. To compliance matters further, the user generally expects various enhancements over the life of the machine, either in software or hardware, which are not known in detail at the time of the selection. The user also is often dependent upon the manufacturer for help in defining his computing requirements and choosing the proper equipment to meet them. As a result of all these factors, the decision of which computer to purchase is seldom a perfectly rational one, but instead is heavily dependent upon the user's judgment about the future actions of the various manufacturers. Equally qualified managers faced with the same information are likely to come to different decisions about which computer best meets their needs (3). As in any situation where clear choices are difficult, the established manufacturers with good reputations have a great advantage over new companies even if the new companies have equal or superior products.

The second factor accounting for brand loyalty is the lack of compatibility among systems. In an extreme case, if all programs were written in assembly language and the two computers had different instruction sets, it would probably not be profitable to switch regardless of the price of the new computer because the cost of transferring all the programs would be equal to the value of the machine. In the more normal case, with most programs in a language such as COBOL or Fortran, the basic programs are usable but some changes are required either in the programs themselves or the job control language. Switching computers is conceivable in this situation, but the new company must offer substantial price discounts in order to induce the customer to pay the cost of conversion.

The compatibility and evaluation problems are largely the result of selecting complete systems and of the incompatibility of various manufacturers' specifications. However, when both of these problems are eliminated, some residual brand loyalty remains. Probably the most straightforward decisions regarding computer equipment are those made between IBM and competitive plug compatible peripheral equipment. Only a single piece of equipment is considered at a time, so systems trade-offs are not involved, and the competitors adopt IBM specifications so that compatibility is not an issue. The only uncertain issue is the reliability of competitive claims for their product versus those of IBM. Even in this simplified situation, an IBM study showed considerable brand loyalty. IBM asked a sample of its disk customers what the maximum discount was that a competitor could offer for a replacement product and the customer still remain with IBM. The results are shown in Table 3.

TABLE 3.—IBM DISK CUSTOMER LOYALTY

[In percent]

Competitive discount	IBM customer remaining with IBM			
	Overall	2319B users	2319A users	3330 users
Over 20	31	24	23	22
16 to 20	46	42	37	36
11 to 15	70	60	58	64
6 to 10	92	86	95	88
1 to 5	97	92	99	94

Source: IBM, "DASD Survey Summary," Mar. 31, 1971, Telex v. IBM, plantiff's exhibit 81.

As can be seen from the table, only a small proportion of IBM customers were potential targets at discounts of less than 10% and 31% would remain with IBM even with discounts over 20%. If the table is accurate, brand loyalty is a substantial barrier to entry even in the plug compatible peripheral market.

The quantity of capital required for entry into the computer industry depends heavily upon the segment entered. Service bureaus, consulting groups, and software houses can have very low capital requirements of a few thousand dollars for initial salaries and office rental before payments begin. Of course, capital requirements may be far larger if rapid expansion is planned or large complex projects are contemplated. Plug compatible peripherals and minicomputers have capital requirements beyond the ordinary range of private financing, but still moderate in comparison with many industries. In minicomputers, the most successful new entrant in recent years, Data General, began with $50,000 in 1968, but raised $20 million more on the stock market between 1969 and 1971 to become an established company. In analyzing potential entry into the memory business, IBM estimated that a new company could begin with $75,000 but would need to invest $15–20 million over a four to six year period before reaching the break-even point (4). The capital requirements for entry into the integrated systems business are huge. When RCA left the computer market in September, 1971, it took a $490 million write-off. In addition, the company estimated that it would have needed a $500–700 million new investment over the next five years in order to attain profitability (5), suggesting total capital requirements of over one billion dollars for a competitive systems company. The amount of capital required is so large that it is unlikely that any new company could raise it, and it is beyond the financing capabilities of all the largest corporations.

Taken together, the capital costs, brand loyalty, and economies of scale form an almost insurmountable barrier to new entry in the integrated systems business. In spite of tremendous market growth and extensive technological changes, no new companies have successfully entered the integrated systems business since 1960. In contrast, there has been continuous entry in peripherals, software, and minicomputer companies, as would be expected from their very low barriers to entry.

The extensive brand loyalty in the computer industry means that all major manufacturers, not only IBM, have market power. Market power is defined as the ability to raise prices above the cost of production, including a normal return to capital, without being driven out of the market. If no manufacturer makes a specific attempt to attack the customer base of another manufacturer through compaibility and/or conversion aids, then all can enjoy high profits and stable market shares. This is equivalent to the practice of price leadership in other industries which allows firms to coordinate their practice and prices without explicit agreements. It has not been the pattern observed so far in the computer industry but appears to be becoming more important. So long as growth in the industry was extremely rapid and the non-IBM manufacturers had a relatively small customer rental base, it was in their advantage to aggressively attempt to expand their market share. However, price competition is very expensive to companies with large rental bases, because a price cut means not only lower revenues on the new customers attracted but also lower revenues from machines placed earlier. Consequently, there is a tendency to concentrate more on upgrading one's own customers than on taking customers away from competitors as the rental base grows larger. IBM's evaluation of competitors for the 370/135 concluded:

"It appeared that many competitors were focusing on protecting and growing their own inventory bases and were not prepared in the near term to get around the M135 in pursuit of IBM's lease base." (6) IBM has been the best example of this "grow your customers" approach to computer marketing, but not the only one. IBM has made a strong effort to develop close relationships with its customers through emphasizing rental rather than sales, and before 1970 by emphasizing a full range of services in addition to the hardware for the basic price. IBM does not provide conversion aids from competitive machines and makes no attempt to directly undercut any given systems manufacturer.

Because of the high cost of switching between incompatible machines, a firm that wants to expand its share of the market cannot simply cut the price of its machines. It must either provide a lower price together with compatibility or provide a technological advance which increases the capability of the machine. Both strategies have been used regularly in the industry. If a substantial increase in the capability of a computer can be made through technical innovation, the innovating company can attract new customers who either are not using computers or who need the new capability enough to pay the necessary conversion costs. Two examples are the Control Data 6600 and the Burroughs Master Control Program. When the Control Data 6600 was delivered in 1964, its capacity was far beyond anything else on the market. Consequently, for very large scale computing needs, such as atomic energy research, the 6600 could easily induce users to

switch from previous computers even without compatibility. Burroughs' Master Control Program for the B-5000 system and related AOSP system for the military oriented D-825 system put Burroughs well ahead of other companies in developing effective multiprocessing capability.

Multiprocessing is the ability to tie several central computers together under a single operating system. Its primary advantage is reliability; if one of the processors should fail, the computer system can continue operating with reduced capability rather than being incapacitated while repairs are being made. One application of the D-825 limited the system to four hours of downtime over a ten year period, an impossible requirement without multiprocessing. (7) Burroughs' early development of multiprocessing and virtual memory capability allowed the company to attract customers needing those capabilities in spite of compatibility problems.

The innovation approach to increasing market share is only successful if the innovation is accomplished successfully without too great cost to the company and if it cannot be easily duplicated by competitors. Transistor computers were probably the greatest single advance in the industry so far. Philco was the first company to introduce a large scale transistor computer, but was followed so closely by the IBM 7090 that Philco gained little advantage from its innovation. Time-sharing has been a very important development since the mid-1960's. However, General Electric made early large investments in time sharing technology but failed to capitalize on its innovations because the costs and technical difficulties were greater than expected.

The third possible strategy is to market directly against a particular computer manufacturer through copying design specifications in order to achieve a high degree of compatibility. This is the most direct method of expanding market share and also the most dangerous for the firm, because it is equivalent to starting a price war. Once compatibility is achieved, customers can more easily leave the aggressive company as well as come to it. The price cutting company must be concerned both with competitive response and the timing of his attack in the product cycle. If the competitive product is introduced late in the target firm's product cycle, it must also be competitive with the target firm's next generation or the rental life will be too short for profitability. The target firm may choose to cut prices as a result of the competition, but it must be concerned for the effect on its own rental base. If only a small proportion of the rental machines are likely to move to the competition, then the firm would be hurting itself with an across the board price cut to restrain competition.

Two of the best examples of the compatibility strategy are the Honeywell H-200 and the RCA Spectra 70 series. During the early 1960's, the IBM 1401 was the most popular computer on the market. Honeywell announced the H-200 in December, 1963, for first delivery in July, 1964, together with a program called the Liberator which would convert IBM 1400 series programs into H-200 programs. The H-200 was a great improvement over the 1400 series for comparable prices, and strong enough to remain competitive with IBM's replacement for the 1401, the 360/30. The success of the H-200 was increased by incompatibility between the 1401 and the 360/30, making it easier for a customer to convert to Honeywell than to upgrade to IBM. The H-200 success brought Honeywell into an early position of stability and profitability in the computer industry.

A less successful example of the compatibility strategy was the RCA Spectra 70 series. Soon after the IBM System/360 was announced in 1964, RCA announced the Spectra 70, a series of four computers each designed to be compatible with, but to outperform its 360 counterpart. The instructions, formats, and character codes were identical to those on the 360. One estimate placed the Spectra prices at 40% under the corresponding 360 prices, but accurate comparison is difficult because of the importance of software and service. (8) In spite of compatibility, the Spectra series did not sell well against the 360. RCA was trying to sell against a largely undefined, rapidly changing target as various enhancements were added to the hardware and software of the System/360, making close comparison difficult for customers to make. In addition, RCA could not offer the same kind of clear price advantage that Honeywell did against the 1401 because RCA was bringing out its machines at approximately the same time as IBM, while Honeywell had the advantage of several years additional technical development. RCA's market share remained at the 2.5-3.5% level of its pre-Spectra days. To make matters worse, RCA's computer division lost $90 million after taxes during the five years of the Spectra-360 competition. (9)

The difficulties in following a competitive strategy with the current structure of the industry make the profits to be earned from competition questionable and

far in the future. So long as a company is consciously undercutting other prices or investing large amounts of money in new technology, it is unlikely to be making substantial profits. It is buying market share for future profits. However, there is always the risk, as happened with RCA and G.E., that the future profits will never be realized. If no firm makes specific compatibility attempts, each can act in a semi-monopolistic manner with a good deal of market protection. Competition and general technological progress cannot be ignored because if prices are too high, other firms will come into the market or customers will switch and pay the conversion costs, but the entire market would be relatively insensitive to exact price comparisons. If no firms made definite attacks on each other's customers through compatibility and lower prices, the industry as a whole would reach its maximum profit position. This would also be the worst position for customer welfare. It appears that the industry is moving in this direction since the exit of RCA.

While full systems suppliers have three strategies open to them, partial line suppliers have only the compatibility option available. Because they are competing for one product on another manufacturer's system, their products can be made obsolete by a change in the systems make specifications, leaving them without a stable base of customers. Technical advances are limited by the need for compatibility with the systems maker's equipment. The partial line suppliers are made dependent upon the systems suppliers because of the lack of independent CPU suppliers. Consequently, at present a customer cannot purchase an entire system without using a CPU supplied by one of the systems manufacturers. An example of the benefits that can come from having independently available CPU's can be seen in the current market for used System 360's. Because leasing companies bought large numbers of 360's during the late 1960's many are available for remarketing and modification. The purchased 360 CPU's have been improved with independent memory, input-output devices, and in some cases enhancements to the operating systems in order to make them far superior machines to what was allowed by IBM specifications. However, the significance of this movement is limited by the numbers of purchased 360's available for modification because no independent company is manufacturing CPU's.

The problems of the independent peripherals companies in competing with IBM are documented in the selection from my forthcoming book, which has been presented as a written supplement to this testimony. Here I will summarize the economic issues involved in the controversies between the peripherals companies and IBM. The basic fact necessary to understanding the problem is that there are high barriers to entry in the systems market but low barriers to entry in the peripherals market. In any situation where a company possesses substantial market power in one product and less market power in a complementary product, the most profitable policy is to tie the products together, refusing to sell one without the other. If the products are totally tied together, the company can choose the prices for each combination to optimize profit, without concern for competition. However, because of legal restraints on tying products, the company may want to raise the prices on the product with monopoly power and reduce the prices on the product subject to competition as a substitute for tying them together. This is not as profitable as tying the products together, but is less likely to get the company into legal difficulties.

IBM has pursued a combination of both strategies in response to peripherals competition. IBM has tied products together where the tie could be technically justified, and has raised the CPU prices while reducing peripherals prices where tying could not be defended on technical grounds. Examples of tying products together are the integration of controllers with the CPU on the 370/145 and later machines, and the tying of large quantities of minimum memory to the basic CPU price on the 370/158 and 168. Although it cannot be established for certain that the integration was a response to competitive pressure rather than simply a design change to take advantage of new technology, the circumstances surrounding the introduction of integration suggest that it was in response to competitive pressure.

Examples of raising the CPU price while lowering the peripherals price in response to competitive pressure were the Fixed Term Plan, which reduced the price of peripherals, followed by a general CPU price increase, and the reintroduction of the 370/155 and 165 as the 370/158 and 168 with a 36–54% increase in CPU price and a 57% cut in memory price. Such price manipulations would not be possible is as much competition existed in CPU production as in peripherals, or if the CPU's were made by a separate company from the peripherals.

The ability of IBM to shift price between peripherals and CPU's reduces the beneficial effects to customers of competition in peripherals as well as threatening the existence of the independent peripherals companies.

A second aspect of market structure which accounts for actions in the peripheral market is the disruption caused by equipment installation and removal, even when compatibility is not a problem. This means that extra revenue can be obtained when a price cut is necessary by requiring an equipment exchange to take advantage of the price cut. This tactic was used effectively with both the 2314 disk drive and the 2420–7 tape drive. In both cases IBM needed to make price cuts in order to remain competitive. In both cases, the price cut products were introduced as new products with identical performance specifications, the 2314 as the 2319 and the 2420–7 as the 3420–7. The price was reduced 31% on the 2319 (from $1455 for three 2314 spindles to $1000 for three 2319 spindles) and 34% on the 3420–7 (from $1020 per month on the 2420–7 to $670 per month on the 3420–7). The customer could only get the price cut by physically removing the old product and installing the new one. The freight charges and disruption involved, as well as the lack of information or lethargy on the part of some computer managers, allowed IBM to have a competitive low price product while still receiving the higher rent from many customers for some time after the price cut.

The third structural characteristic that accounts for the actions of IBM toward the plug compatible manufacturers is the necessary time lag between IBM introduction of a product and competitive copying of it in order to insure compatibility with constantly changing IBM systems specifications. In the early days of peripheral competition, IBM overestimated this lag and erroneously felt that it would make the PCM competition a minimal threat. Later, IBM introduced the fixed term plan and more rapid minor product changes in order to capitalize on the time lag. When a new product is introduced, customers have little incentive not to accept it on the fixed term plan because no competitive replacement was ready. The heavy penalities for early termination under the FTP effectively reduced the competitors prospects to those customers finishing a lease. By making rapid minor product changes, such as switching control functions between drives and control units, IBM was able to further reduce the PCM's marketing effectiveness without reducing prices.

The foregoing analysis is not meant to suggest that there was anything wrong with IBM reducing prices. Prices of peripherals before the competitive companies entered the market were much higher than necessary to give a normal return to capital. The proper functioning of a competitive market as well as technological progress should and did force the prices of peripherals down. The problem is that customers did not get all the benefit of the lower prices; some of the savings from the peripherals was merely transformed into higher prices for the CPU. The beneficial effects of competition in peripherals were thwarted by monopoly power in the production of CPU's.

In considering possible methods of improving the performance of the computer industry, it is necessary to concentrate on removing the factors which have led to the current problems. Because of the brand loyalty which arises from integrated systems production, splitting IBM into several smaller integrated systems manufacturers would be unlikely to solve the problem. The greatest current competitive emphasis in the industry has been from the independent peripherals makers, not the smaller systems suppliers. Although the industry would be more competitive with less dominance by one firm, it would not be likely to reach the best possible performance. A better solution is to split IBM by functions; to make separate companies out of the production of CPU's, peripherals, maintenance, and marketing functions. This would prevent monopoly power in one segment from being spread into the other segments. There will continue to be barriers to entry to the CPU business because of the economies of scale in the production of systems software, but that market power could not be enhanced by control over a wide variety of other activities. If such a split were made, each segment of IBM would have to compete on a fair basis with other companies. If IBM were really more efficient, it would continue to dominate. However, it could not use power in one area to manpulate standards or price ratios in order to fight competitors in another area. Neither could one activity subsidize another because they would be separate companies.

The proposed type of organization already exists to some extent in the minicomputer market, and appears to be very effective. Minicomputers are generally sold as distinct components, CPU, software, peripherals, etc. Although the major manufacturers do provide complete systems, it is also common for systems to be

made up of several manufacturers' components. Specialized companies have been formed to choose the appropriate minicomputer system components, write software, and deliver complete packages to customers.(10) A wide selection of peripherals is offered by many different manufacturers with interfaces for a variety of minicomputers, rather than only for one manufacturer's product as in the main systems industry.(11) The British National Computing Centre is developing a common assembly language for a substantial number of minicomputers in order to provide total program compatibility.(12) Entry into all phases of the minicomputer business has been easy, prices have dropped rapidly, and the entire industry has been much more competitive than the main systems industry in spite of relatively heavy concentration.(13) Consequently, it appears that the lack of competitiveness in the main computer industry is a result of integrated systems selling rather than concentration in itself.

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10. Michael Merritt, "Small Businessmen Get Special Care from Vendors," Computerworld VI (August 30, 1972), p. S–8.
11. Vic Farmer, "Minis, Peripherals Dominate New NCC Hardware Products," Computerworld VIII (May 15, 1974), p. 9.
12. Don Leavitt, "Is One Assembler OK for all Minis" Computerworld VIII (March 20, 1974), p. 17 and John J. Archer, "'Unisym' Discounts Differences Among Minicomputers," Computerworld VIII (July 3, 1974), p. 13.
13. Digital Equipment had 44% of the number of minicomputers shipped in 1973 and Data General had 11%. "Minicomputers that Run the Factory," Business Week (December 8, 1973), p. 76.

Exhibit 2.—*Excerpt From "Competition Among Peripherals Suppliers," Re Problems of Independent Peripherals Companies in Competing With IBM*

[*Taken from Gerald Brock, "The U.S. Computer Industry 1954–1973: A Study of Market Power* (Cambridge, Mass. Ballinger Publishing Company, forthcoming), Chapter 8. Copyright 1975, Ballinger Publishing Company. Presented to the Subcommittee on Antitrust and Monopoly, U.S. Senate, by permission of Ballinger Publishing Company.]

Chapter 8.—Price and Product Actions—Partial Systems

The previous chapter outlined three strategies that have been followed by complete systems manufacturers; technological innovation, compatibility, and product differentiation to protest one's established market. This chapter extends the analysis to competition between the systems manufacturer and companies which supply only parts of the system such as a tape drive or a disk drive.[1] The poten-
not perform as expected, it can generally be replaced rapidly and without substan-

[1] In order to avoid confusion over the many products discussed in this chapter, a summary description is contained on the last page.

tial strategies are much more limited in this situation. Because the product is designed to replace part of a system, it must be compatible with the other parts of the system. Because of the need for compatibility, the partial line company does not have the option of introducing new products before the full systems manufacturer; it must wait until the specifications of the target product have been revealed and then try to duplicate them. Partial products therefore always have a shorter effective life than the products they are designed to replace. A full line system can continue competing against a competitor's new line by lowering the price, but if the CPU is replaced and the new CPU requires different peripherals, then the partial line producer cannot sell his old product regardless of the price.

The partial line producer does have an important advantage over the full line producer who tries to achieve compatibility. No complete system has yet been devised which could replace another manufacturers system without some changes to programs, incurring a cost and the possibility of significant disruption. A carefully designed peripheral unit can replace another unit without any change at all in programs or job control language. The customer can then ignore the problems of evaluating weighted averages of various characteristics and only be concerned with the price of the replacement product and whether the product performs as well as the product to be replaced. Almost perfect compatibility can be achieved except for the problem of confidence in whether or not the replacement product will perform as promised. Even the confidence problem is much less serious than in complete systems because if the replacement product does not perform as expected, it can generally be replaced rapidly and without substantial cost by the original product. The partial line supplier is freed of the largest area of economies of scale, software, and of the greatest difficulty in achieving market acceptance, the cost of conversion and difficulty of evaluating complex products. Less capital is required than for full systems manufacturers. Consequently, the barriers to entry are far less than in the systems market. The barriers are not zero because of the economies of scale in production and the generally shorter life of the replacement products, but prices cannot be raised very far above the competitive level without attracting new competitors.

Independent companies have manufactured components for computer systems since the earliest days of the industry. However, before the late 1960's, these components were sold to the computer systems manufacturers rather than directly to the final customers. For example, both Honeywell and RCA purchased disk drives from Bryant Computer Products in the early 1960's and then incorporated the drive into their systems. Each system manufacturer's CPU required a different interface with the peripheral units, and in many cases, different models of the same system manufacturer's line could not be attached to the same peripheral unit. With the introduction of the IBM System/360 with a standard peripherals interface for all models, a much wider market for each single peripheral unit was created. With some limitations, the same tape or disk drives could be attached to any model of the System/360. The standard interface, combined with the tremendous success of the 360, created a large target for direct marketing of peripheral units to the end user in competition with IBM.

The marketing of replacements for the IBM 729 and 2401 tape drives in November, 1967 marked the beginning of competition for IBM peripheral units. The drives were manufactured by Potter Instrument Corporation and marketed by MAI (Management Assistance, Inc.) to end users in direct competition with IBM. In June, 1968, Telex entered the market with a replacement for the 729 and 2400 drives.(1)* By July 1968, IBM was concerned enough about the beginnings of peripheral competition to study the problem in detail. IBM considered the companies a potential threat to all revenue represented by "basic systems I/O", which IBM defined as "channel attached devices for general application and use." At that time the value of basic systems I/O on IBM machines was only slightly lower than the value of CPU's installed ($93 million per month rental versus $101 million per month for CPU's.) Thirty percent of the basic systems I/O was accounted for by direct access devices such as the 2311 and 2314 disk drive and the 2321 data cell, 35% by tape drives, 22% by printers, and 13% by card equipment. The tape drive and disk drive market were the ones subject to immediate attack.

At that time, a total of 35 MAI tapes drives were installed. In addition, six replacement 2311 disk drive spindles manufactured by Memorex and marketed by MAI and one 2311 spindle manufactured by Marshall labs were installed, and 1400 were on order. IBM had 19,000 2311 spindles installed with 10,500 on

*References may be found on p. 5680.

order in the U.S. with another 15,000 on order or installed in other countries. IBM rented the drives at $590 per month and sold them for $25,510. The Memorex drive was plug compatible with the IBM drive; that is, it could be attached to the IBM 2841 controller without any changes in the rest of the system. The only substantial change was a different arm movement technology which gave the Memorex drive a 33% faster access time. The Memorex drive rented for $500 per month (15% price cut over IBM) and sold for $15,500 to $20,000 depending on quantity (39% to 22% price discount over IBM).

In July, 1968, practically no equipment had been delivered by the plug compatible companies, but several companies were poised for a large scale attack on IBM's peripherals market. Telex, MAI, Mid Western Instruments, and Data Processing Financial & General had all announced replacements for IBM's 729 or 2400 series tape drives with price cuts up to 57% over IBM and equivalent or better performance. MAI, Marshall Labs, and Potter had all announced replacements for the 2311 disk drive, and Memorex had announced a 2314 replacement. Given the large price differentials offered by the independents and the lack of compatibility difficulties to protect IBM's base, IBM could have been expected to see a large threat to their installed base. However, IBM concluded at that time that it was "too early to forecast effect" of the competition and that "IBM strategy sound over plan period". The IBM strategy for protection of the disk market was a double density 2311 for delivery in 1969 (never done) and a "2314 B Prime" (the 3330) for delivery in 1972. The tape protection strategy was to develop a new techology to replace the exposed drives and to make "tactical 729 price cut" while moving the rental from the drive to the controller. (2)

During the following year, the potential peripheral threat became a reality. The numbers installed remained fairly small as the companies built up production capacity and attempted to overcome initial customer reluctance to accept non-IBM equipment for direct attachment to IBM systems. The IBM prices were high enough that the independents were profitable in spite of large price discounts and less production efficiency than IBM. The changes in technology since the IBM target products had been designed allowed the companies to offer higher performance as well as lower prices and compatibility, a very attractive package.

By July, 1969, IBM was becoming more concerned with the previously forecast limits on competitive penetration. The Management Committee minutes state: (3) "Hume reported that he had investigated OEM inroads in the tape area and concluded that our forecasts regarding competition are low by a factor of two. . . . The DP Group is now working on alternative actions including the possibility of price actions. Opel entered and stated that at this point he is against any price action but that Frank Cary feels differently."

The question was whether a price cut of sufficient magnitude to stop the peripheral competition at that time would have been more costly in terms of lost rental revenue than the lost market share due to the competitive inroads. In retrospect, it appears that a substantial price cut early in 1969 on exposed peripheral products would have largely prevented the plug compatible industry from developing, an advantage worth more than the temporary loss of revenue from IBM's point of view. Companies contemplating entering a new market are carefully attuned to the profit possibilities in that market. If the price is cut enough that the market does not appear profitable, companies will not make the investment. However, once a company has entered a market, it will be reluctant to leave if there is any possibility of future profits. Consequently, a much more substantial price cut would be required to eliminate established competition than to prevent new entry. However, at the time, IBM felt that the plug compatible competition would remain small in spite of IBM inaction and that therefore a price cut was not needed.

As the plug compatible manufacturers (PCM) continued to flourish during late 1969, IBM's concern increased. In January, 1970, the General Services Administration requested each agency to provide a list of all IBM 729 and 2401 series tape drives and all 2311 and 2314 disk drives on lease. The agencies were also to indicate for each machine that it was being replaced with a PCM machine or a reason for maintaining the higher priced IBM version. Also that month, IBM undertook a complete survey of all installed IBM equipment to get an exact count of the PCM attachments. The results are shown on Table 8–1. While the total PCM installations in early 1970 remained a small percentage of IBM's peripheral products, it could no longer be treated lightly, especially in light of the GSA order. The GSA order was significant not only for the potential losses of large numbers of government installations, but also for its effect on private

companies. If the government were involved in an active program of switching to PCM peripherals, private companies would be less hesitant to install non-IBM equipment. In February, 1970, the peripheral problem was designated a Key Corporate Strategic Issue, an IBM method of focusing attention on major problems which required intensive study and management decision making. A task force was set up under H. E. Cooley, vice president of the Systems Development Division, to carry out an examination of the extent of the PCM problem and potential solutions for IBM.

TABLE 8-1.—IBM AND PCM PERIPHERALS–JANUARY, 1970

	PCM installations	IBM installations	PCM percent of IBM
Device:			
729 tape drives	1,214	6,820	17.8
2400 tape drives	1,713	45,010	3.8
2311 disk drive spindles	971	23,730	4.1
2314 disk spindles	3	[1] 40,000	0.0

[1] About.

Source: IBM, "Data Processing Group Peripherals Task Force," April 7, 1970 (Telex v. IBM, plaintiff's exhibit 19).

The Cooley Task Force made a careful examination of the plug compatible problem during the second quarter of 1970. At the time of the task force report to IBM's Management Committee in July, 1970, PCM companies had gained 4% of IBM's disk drive market and 11% of the tape drive market, up substantially from the January survey. If no changes were made to the IBM plans, the task force projected that by 1976, the PCM's would only have 11% of the tape market and 15% of the disk market. (4) Although this penetration meant a substantial loss of revenue, the Management Committee decided that no further action was called for to protect the 360 peripherals, and that attention should be concentrated on new products for the 370 series, the first models of which had been announced the previous month.

Among the possibilities considered by the Cooley Task Force for protecting the 370 peripherals were "mid-life kickers", proprietary diagnostics, unique interfaces between peripherals and CPU's, and physical integration of control units inside the CPU, as well as an increased level of research in new technologies. The "mid-life kickers" idea was to add small improvements to products every six months in order to incorporate new technological advances. The idea was also expected to fragment the market and to avoid a large base of identical IBM products toward which the PCM's could direct marketing efforts. Proprietary diagnostics would have been diagnostic programs which could recognize the difference between an IBM and a PCM devise and would fail to work properly on the PCM device. One of the advantages PCM's had gained through compatibility was the ability to use IBM's established diagnostic programs for maintenance, thus saving the cost of developing their own diagnostics. Regarding the proprietary diagnostics, Cooley wrote: "The proposal which would make concurrent maintenance an IBM exclusive could be a real swinger." (5)

The purpose of unique interfaces was to make it more difficult for PCM's to attach their equipment to IBM channels, against increasing costs and forcing the PCM's to develop many variations of their products rather than a standard line. Regarding this, Mr. Cooley was warned during the study period that IBM's Basic Channel Adapter which would have further standardized interface "is a step in the wrong direction since a competitor could easily attach a communications subsystem." (6) Physical integration of the control units would have reduced the PCM market as well as made attachment more difficult. Control units are small processors which control the operation of one or more types of peripheral devices. The initial PCM tape drives and 2311 disk drives attached to IBM control units, but the 2314 disk drives and later tape drives came with their own control units which then attached directly to an IBM channel. Depending on the configuration used, the control unit could amount to 50% or more of the cost of a disk system. If the control unit was put inside the CPU, the PCM's would have no chance to replace it and would also have to use the IBM interface between control and drive instead of only between control and channel, restricting their design freedom.

The primary recommendation adopted initially from the Cooley task Force was the Mallard Program, described by Cooley as "the plan we came up with to kludge three 2314's repriced into the NS 1".(7) The Cooley report also recommended price cuts but the Management Committee refused. The Mallard Program was announced as the 2319A with the Integrated File Adapter for the 370/145 in September, 1970. The Integrated File Adapter (IFA) was a modified 2314 control unit put under the covers of the CPU where it was safe from competition.

The controller price was cut from $1420 per month to $555 per month for the IFA version. The 2319 was a set of three 2314 spindles put together in a single box along with some of the control electronics previously in the 2314 controller. The price was set at $1000 per month for the three spindle box compared with the price of $1455 for three 2314 spindles. The total cost for a three spindle drive and IFA controller dropped from $2875 per month to $1555 per month. a 46% price cut which brought IBM's price well below the price of any of the independents. However. the new combination could only be used on the announced but undelivered 370/145; it could not be fit on the existing base of 360 machines. The 2319A program protected disks for the 370/145 both because of its low price and because of the difficulty of attaching independent drives directly to the integrated file adapter. Similar programs with integrated controllers were planned for the remaining unannounced machines in the 370 line.

The 2319 program gave the improved price performance in disk drives that could have been expected with a new series without the necessity of developing a new medium speed technology or manufacturing new drives. Because large users were expected to be returning 2314 spindles as they switched to the 3330 (IBM's high performance new technology disk drives for use on large 370 models), IBM could expect an ample supply of 2314 spindles to repackage as the 2319A for smaller 370 users without substantial cost. By restricting the program to the 370, IBM was able to continue charging the full original rental for the lage base of 360 based 2314 spindles installed on rent. The 2319A program was expected to save 1,200 spindles from competition without a general price cut on the 2314 drives.

TABLE 8–2.—FORECASTED PRICE SENSITIVITY OF 2319A PROGRAM

2319 spindles	$1,000 per month	$1,200 per month	$1,400 per month
Revenue (million)	$178	$189	$188
Profit (millions)	$58	$69	$74
Profit (percent)	33	37	39
Additional 2314 type spindles on 370 systems:			
Revenue (millions)	$174	$152	$133
Profit (millions)	$86	$74	$65
Profit (percent)	49	49	49
Total revenue from 2314 type spindles on 370:			
Revenue (millions)	$352	$341	$321
Profit (millions)	$144	$143	$139
Profit (percent)	41	42	43

Source: IBM, "Mallard Financial Analysis," September, 1970 (Telex v. IBM, plaintiff's exhibit 135), p. 17.

As with other products. IBM prepared an extensive forecast of the effects of different prices for the 2319 before announcement. The detailed announcement showed acceptance. removals. and inventory for both lease and purchase at various prices for all 2314 type spindles on the System 370 machines for each year from 1971 to 1979. A summary of the Mallard forecast is contained in Table 8–2. As can be seen from the table, the highest profit percentages occur at the $1400/month price. but the highest absolute amount of profit occur at $1000/month. The 2319 program itself made the highest profit at $1400. but the lower price on the 2319 was expected to sell enough additional 2314 spindles at the original prices to overcome the advantages of higher profits * * * of previous expense to the new program. An analysis of the source of increased sales at the lower price predicted that 40–45% of the increased sales would come from increased demand both for complete systems and for disk spindles on current systems. and 55–60% of the increase would come from saves from PCM companies. The PCM companies were expected to get 23% of the 2319 spindles on 370 systems at the $1400/month price and 6% of the 2314 spindles at the $1000/month price (8). The low elasticity of demand for IBM 2314-type spindles in the

absence of consideration of PCM effects indicates that there would have been no incentive to cut the price on the 2319 if the PCM competition had not existed.

The decision to concentrate on protecting the 370 base of peripherals rather than taking strong action to stop inroads into the huge installed 360 base was based on a presumption that PCM competition would be limited to a small percentage of the 360 base, that the 360's would rapidly be replaced by 370's, and that the PCM companies faced stingent capacity contraints. However, PCM penetration of the 360 base was much faster than expected during late 1970. Of particular concern to IBM was the PCM success in replacing installed 2314's, a base of 47,000 spindles amounting to twenty-three million dollars per month in rental equivalent. When combined with the assoicated controllers, the value of installed 2314's was greater than that of the entire equipment installations of any company other than IBM. An IBM study in late 1970 showed that total losses to PCM's had risen from $1.4 million monthly rental value in 1969 to $4.2 million monthly rental value in 1970. Eighty-two percent of the increase was due to increased 2314 penetration which changed from zero in 1969 to $2.3 million monthly rental value in 1970. (9).

In October, 1970, a second peripherals task force was organized to examine the costs and capabilities of the PCM's in more detail than the Cooley task force had done, and in particular to determine how low the peripheral companies could go on 2314 prices and when they would be able to produce a replacement for the 3330. At the time, Telex was the largest PCM competitor. IBM's analysis of Telex's 2314 costs showed that the break even point for Telex with no profit margin or contingency fund was at a monthly rental of $381 per month, per spindle, based on a sixty month life. (10). IBM's analysts concluded that if the 2319 was offered for the 360, Telex's necessary price cuts on its 2314 equivalent drives would eliminate all profits and cause Telex to incur a $1700 loss on each drive. (11)

In December, 1970, IBM announced the 2319B, a provision to extend the 2319 to the 360. The three drive 2319 at $1000/month ($333 per drive) was made available for attachment to a modified 2314 controller on the 360 system rather than only to the Integrated File Adapter on the 370. The modified controller was left at the original price of $1480 per month. Although they had exactly the same performance specifications, the repackaged 2314 spindles were treated as a different product than the installed 2314 spindles. The 26% price cut on 2314 spindles was not available to installed equipment. In order to get it, the customer had to order a 2319 system and have it physically exchanged for the installed 2314 system. This arrangement restricted IBM's revenue loss from the announcement. Customers who were not particularly aware of the market place and were satisfied with their current equipment were likely to miss the announcement or fail to give it serious consideration. Customers who were planning a relatively quick upgrade to 3330's or other new equipment were not likely to face the disruption of ordering and installing new equipment with the same performance as the old for a short term reduction in rental. An IBM analysis stated: (12)

"Customers installing 2314–B Series drives will largely be replacing installed A Series equipment. A majority of these installations will be for over 1 year or the customer would not accept the freight charges and system downtime involved in the conversion."

The primary customers taking immediate advantage of the 2319 announcement could have been expected to be those considering switching to PCM equipment. The 2319 achieved a substantial amount of price discrimination through inertia, the delay between order and delivery times, freight charges, and the disruption of removing and installing equipment.

The 2319 price per spindle was below the lowest price then charged by a PCM company. The PCM companies reduced prices substantially immediately following IBM's announcement. The new prices were lower than IBM's 2319 price, but not as great a differential as before the 2319 announcement. For example, Telex cut its prices on a complete 2314 subsystem by 8% to 15% depending on the number of drives chosen, while the IBM cut amounted to a 20% to a 25% reduction. This reduced Telex's price advantage over IBM from 22–27% before the 2319 to 12–16% after the 2319. (13) In addition, the PCM companies offered greater flexibility because they would sell any number of drives while IBM would sell only multiples of three on the 2319 plan, while charging the higher 2314 price for numbers not multiples of three.

At the same time as the 2314–2319 changes were being made, IBM made a similar revision to its tape. IBM's primary tape drive systems for the 360 was

the 2401 family. In order to take advantage of technological advances, IBM announced the 2420 tape drives in 1968, a significant advance over the previous drives which was supposed to fill the need for high performance tapes on both the late 360's and the then unannounced 370 series. The 2420–7 was announced in January, 1968 at a price of $1020 per month. It had a data transfer rate of 320,000 characters per second, 78% faster than IBM's previous high capacity tape drive, the 2401–6. The 2420–7 was priced 22% higher than the 2401–6, making the new series more price effective than the old for high volume users. In November, 1968, the improved price-performance of the 2420 drives was extended to lower volume users with the announcement of the 2420–5, a half speed version of the 2420–7, for $565 per month.

IBM thought the earlier tape drives were exposed to PCM competition, but at the time of announcement, the company thought the innovative technology employed on the 2420 drives protected them from competition. Consequently, high profit margins were set on the drives. An early 1969 forecast, made after announcement but before delivery of the 2420, predicted a profit margin of 42.9% for the 2420–7 and 28.4% for the 2420–5. The 2420 series of tape drives was expected to earn a total revenue of $1676 million dollars over their lifetime with a total profit of $538 million, for an overall average margin of 32%. (14) The differential profit margins on the 2420–5 and 2420–7 allowed IBM to extract maximum revenue from high volume users while not pricing lower volume users out of the market.

Encouraged by their success in replacing 2400 and 729 series tape drives, and attracted by the high potential profits of replacements for the 2420, several PCM companies began developing 2420 capability. By 1970, Potter, Storage Technology, and Telex had announced replacements for the 2420 at prices far below those of IBM. Recognizing that the high profit margin on the 2420–7 made it a very weak competitor once the technology was copied, IBM began planning charges in the line. A simple price cut was rejected in favor of a "new" tape drive. In November, 1970, the 3420 series of three tape drives was announced. The top two models of the 3420, designated the 3420–5 and 3420–7, were identical in physical and performance specifications to the 2420–5 and and 2420–7. The bottom model, the 3420–3, had no counterpart in the 2420 series. The 3420 was expected to correct the pricing mistake made on the 2420 from underestimating competition. Soon after the 3420 announcement, an IBM tape analysis stated: (15)

"Plan 23 [April, 1969 forecast] predicted the resumption in 1970 of better than 10% annual growth, subsequent to introduction of the 2420 series. The flattening inventory total during 1969 is an acknowledgment that the 240X tapes were becoming less attractive. Although by then the first PCM competition was recognized, it was not viewed as a threat serious enough to alter IBM's growth in this market. Hence, the 2420's were introduced with high price umbrellas. By mid-1970, the installed base was swiftly eroding and only the 3420 announcement was expected to reverse the situation."

The price of the 3420–5 was set at $560 per month, almost identical to the $565 per month charged for the 2420–5. However, the 3420–7 was priced at $670 per month, a 34% price cut over the 2420–7 with identical performance specifications. As with the 2314–2319 price cut, the new price was not available on the installed 2420–7 drives; the customer had to remove the 2420–7 and have it replaced by a 3420–7 in order to receive the new price. The 2420–3420 manipulation was slightly different from the 2314–2319 change because the 3420 did contain some new technology, but from the user's point of view, the two series were effectively identical.

Besides being a price cut, the 3420 series pricing reflected more concern for competition than the 2420 through the profit margins chosen for various models. An analysis of the potential market for the 3420 before announcement concluded: (16)

"Due to the increased amount of competition, it is our belief that the concept of functional pricing is no longer the best suitable way to price in the magnetic tape area. Apparently manufacturing cost of high and low performance drives do not differ substantially and competition has concentrated in the higher performance area and priced their drives very competitively . . . a continuation of this policy would contribute to future losses."

Functional pricing means charging according to the performance of the machine, rather than according to its cost. If there is no competition, functional pricing leads to the maximum profit. However, if competition is present, functional pricing causes competitors to concentrate on the machines with the

highest profit margins, squeezing the original firm out of the market and bringing down the price. In a highly competitive market, all products with similar production requirements (such as the various models of a tape drive family) will have the same profit margin. A compromise between functional pricing and competition oriented mark-ups was adopted in the 3420 program. The estimated profit margins at the time of announcement were 29.2% for the 3420–7 (versus 42.9% for the 2420–7), 26.5% for the 3420–5 versus 28.4% for the 2420–5), and 15.2% for the 3420–3. (17)

At the time of announcement, the 3420–7 price was equal to or lower than the prices of the 2420–7 competitors. Following the 3420 announcement, the PCM companies cut prices on the 2420 drives or announced new products in order to remain competitive. As with the 2319, the new prices put the competitors below IBM but did not restore the full percentage differential existing before the IBM cut. Following the 3420 announcement, competitive prices for the 3420–7 equivalent drive ranged from 10% to 15% under IBM's price; while before the 3420, the competition had undercut the 2420–7 by around 30%. (18) The 3420 program put a quick end to the 2420 program, causing a drastic reduction in revenue and profits over what had originally been planned. It did not immediately end the 2420 program because of long delay times for delivering the 3420 (eighteen months) and the expense and problems caused by removing the 2430 in order to put in a 3420. The expected 2420 revenue was cut from $1676 million in early 1969 to $281 million after the 3420 announcement, and the expected profit from $538 million to $24 million. The drastic cut in total revenue while overhead expenses associated with the 2420 program continued cut the expected profit margin on the entire program from 32% to 9.3%. (19)

While not restoring the full percentage differentials which existed before the 2319B and 3420 programs, the PCM price cuts following IBM's actions allowed their continued rapid penetration of the IBM tape and disk base. PCM 2314 type installations continued to accelerate, climbing from 2639 spindles in December, 1970 (at the 2319B announcement) to 3006 in February, 1971, 3491 in March, and 4614 in April, 1971. By April, 1971, the PCM installation rate was 915 drives per month (20% per month growth rate) and the order rate was 1022 drives per month. (20) Tape drive replacements also accelerated, but much more slowly than disks. At the end of 1970, the PCM companies had 4000 2400 series tape drive installations and were adding to them at 190 per month (5% per month growth rate). (21) During 1971, the installation rate rose to 220 per month. (22) At that rate it would have taken over eight years to replace all of IBM's tape drives.

While accelerating their installations of tapes and disks during early 1971, the PCM companies also extended their product lines to memories and printers. By February, 1971, memory competition was just beginning. Twenty-five main memories had been replaced by competition (23 by Data Recall and 2 by Fabritek) and 31 large core storage memories had been installed. (23) However, the memory market was a cause for concern because memories accounted for a large fraction of the value of the 360 CPU's and advances in core technology had allowed independent memory companies to fabricate memories far below IBM prices.

Effective memory competition was not only a threat to current 360 revenue, but low prices on memory could reduce the migration of 360 users to the 370, because one of the primary attractions of the 370 was a much lower memory price then the 360. Competition in the printer market was also just beginning with five installations by February, 1971. Telex's entry into the printer market had a 6–23% price advantage over IBM's popular 1403–N1 as well as higher performance, and in dual configurations Telex's printer could out perform IBM's new 3211 printer for the system 370. Printers accounted for about 10% of the value of IBM installed computer systems, somewhat less than either tape or disks.

With the PCM penetration accelerating rapidly in spite of the System 370 product innovations and the 2319 and 3420 price cuts, IBM appointed another study group to devise stronger methods of protecting the 360 base of installed peripherals. When the new study group, designated the Blue Ribbon Task Force, was appointed, peripheral equipment potentially subject to attack by PCM's accounted for 63% of IBM's lease base. The Blue Ribbon Force recommended extreme price cuts in order to eliminate the PCM problem. On the 360 inventory of equipment, the task force recommended a 50–55% reduction on 2311 and 2314 disk drives and controllers, and a 50–80% price cut on the 2401 and 2420 families of tape drives and controllers. The study group also recom-

mended a 20% drop in the price of the new 3330 disk system for the 370 (not yet delivered at that time, but announced and many on order), and a 15% price cut on the new 3420 (Aspen) series of tape drives for the 370. On May 6, 1971, the Management Review Committee rejected the recommended price cuts and instructed the task force to work on a term lease plan as an alternative. (24)

The drastic price cuts recommended would most likely have eliminated the PCM problem both by reducing prices below costs for existing companies and by forcefully telling potential new companies that peripheral competition would not be tolerated. However, it would also have cut IBM revenues drastically because the cuts applied to such a large base of equipment, and would have practically guaranteed an antitrust conviction for IBM for predatory pricing. At that time, all IBM lease products were cancellable on thirty days notice, while many competitive products were on one year or longer lease plans. An IBM long term lease plan would have been both a convenient excuse for cutting prices and a method of protecting the installed inventory. With appropriate penalty provisions in the lease, a customer would not consider a PCM replacement except at the time his lease was up. This would restrict the marketing flexibility of the PCM companies, and in particular, it would restrict their attacks on the new devices being delivered with the System 370. Because of the need for compatibility, the PCM companies could not deliver a replacement for a new product until after IBM had delivered the product, and if the products went in on a two year lease, the PCM would be prevented from marketing a replacement until two years after deliveries began. An IBM analysis showed that a term lease plan which protected the market for twenty months would turn PCM profits on the initial placement into losses. The analysis assumed that the initial placement of the PCM machine would be lost at the time IBM brought out a replacement product, but that the company could remarket the machine at a lower price to another customer. The remarketing effort would only incur marketing and maintenance charges because no manufacturing or development would be necessary and the profits from the follow on customer would make up the losses on the initial placement for a profit on the entire product life. However, the analyst concluded that because profits were deferred for so long, the company would have difficulty developing a follow on product and therefore that with an effective term lease plan "PCM corporate revenues lower—no funds for mfg., eng.—dying company!" (25)

At the recommendation of the Blue Ribbon Task Force, the IBM Management Review Committee approved the Fixed Term Plan on May 25, 1971, and announced it two days later. The Fixed Term Plan (ETP) allowed one or two year leases on most tape, disk, and printer products. The customer received an 8% discount over the month to month rental for a one year lease and a 16% discount for a two year lease. All extra use charges (charges above the basic monthly rental, which only entitled the user to 176 hours per month) were eliminated on products under the FTP, making the effective discount for a two year lease between 20 and 35%. If a product on a one year lease was cancelled before the lease period was up, the customer was charged a penalty equal to two and one half times the monthly rental charge; if a two year lease was broken during the first year the penalty was five times the monthly rental. Card equipment, CPU's, and System 3 equipment were not eligible for FTP. Before this time IBM had rejected the idea of long term leases because it felt there was no way to justify leases on some products without applying it to the entire product line, but by May, 1971, the company was so concerned with its peripheral competition that it downgraded the possibly adverse public relations aspects of the FTP for peripherals only. The discounts available with the FTP, put IBM prices below PCM prices. IBM estimated that the FTP would cost the company $31.5 million in 1971 and $44.1 million in 1972, but that the reduction in PCM competition resulting from FTP would bring in enough increased revenues in 1973 and later to make the total effect of FTP a gain in revenue of $714 million between 1971 and 1975. (26)

The potential danger to the PCM's posed by the FTP was quickly recognized. The plan was announced May 27. Between May 26 and May 28, Telex stock dropped 14%, Potter Instruments stocks dropped 10%, Memorex dropped 15%, and Marshall Laboratories dropped 18%. Potter, Telex, and Memorex continued to lose value on the stock market throughout the next month. The following selection of comments from the trade press following the FTP announcement indicates clear comprehension of the intent of the price cuts: (27)

". . . the competition will be shooting at IBM leftovers: new delivered peripherals, leasing company installations, and—camaraderie be damned—each other. . . .

. . . Too much slick pricing maneuvering on the part of IBM just could arouse the Justice Dept., which has maintained a deafening silence in the wake of IBM's recent actions (price cuts, etc.) that have sent shock waves throughout the industry. . . . The new deal, affecting an estimated 80% of IBM's installed perpherals on rent, was aimed squarely at independent manufacturers of plug-to-plug compatible peripherals which System/360 users have been installing at big savings in both price and performance. . . . IBM not only lowered prices, it also lowered the ability of its competitors to get cash to finance a negative cash flow by lowering their profitability."

IBM's FTP was an immediate success with its customers. Within a month of announcement, 40% of IBM's eligible customers had signed up for the new plan, a coverage not expected by IBM until six months later. Ninety percent of the new 370 peripherals (3330 disk drives and 4320 series tape drives) were being installed under FTP during June 1971. IBM considered the 3330 protection especially significant because the first PCM 3330 had been announced but none had yet been delivered by May, 1971. IBM concluded that in spite of the assumed 10% price advantage of the independents on the 3330, "it is assumed that near-term 3330 erosion will be contained until the FTP contracts approach maturity: By that time, Winchester, Iceberg, the 3330A/B and the 333M will all be available as customer options and should hold the market for IBM." (28)

The PCM companies reduced prices following the FTP in order to bring their prices under IBM's, but not enough to fully restore the pre-FTP differential. An IBM study of reactions to the FTP six weeks after the announcement reported that "Telex and Memorex have maintained their list price differential to the 2319B, but they did not absorb the percentage decrease attributed to IBM's additional usage', and that Ampex and Potter had made "selective price reduction". (29) Another study showed that PCM discounts ranged from 4% to 28% on 2314-type disk systems, depending on the configuration, length of contract, and PCM company. (30) The combination of smaller price differentials, penalties for removing IBM equipment early, and customer uncertainty about the long term viability of PCM companies in the light of IBM actions reduced the order rate substantially. IBMs December, 1971 Quarterly Product Line Assessment reported that after the FTP, the PCM tape order rate declined 62% and the disk order rate declined 48%. (31) The PCM order rate for the entire year following the FTP announcement was 44% lower than for the year preceding the announcement. (32)

The FTP marked the end of the plug compatible companies as successful, profitable competitors to IBM, but it did not stop them from operating. Between the instigation of the FTP and the end of 1973, none of the major PCM companies were profitable, their sales declined, and their stock market values plummeted. In the two years following the FTP, Telex's stock market value dropped from $198 million to $48 million. (33) The companies' depressed earnings and stock values made it difficult to raise capital for development of new products and made IBM's prediction that FTP would lead to PCM's becoming "dying companies" seem quite accurate.

While the PCM companies were feeling the pinch of the lower prices under the FTP, IBM made up the lost revenue through a price increase in CPUs and memories. On July 28, 1971 (two months after the FTP announcement), IBM announced rental and purchase increases in 360 and 370 CPU's, channels, card equipment, and maintenance. The increases varied from 4% to 8% on different pieces of equipment, with some maintenance charges increased up to 25%. The purchase increases became effective the date of announcement and the rental increase ninety days later in accordance with the notice of price change provisions in IBM rental contracts. The rental increases were then further delayed by the August 15, 1971 price freeze which was instituted between the announcement and effective date of the rental increase. In August, 1971, one of IBM's analysts wrote concerning the price increase: "Although there will probably be adverse reaction on the part of some customers, the net effect of the FTP and price changes will not significantly increase his total costs and no systems decreases were forecast." (34) IBM was able to cut prices on one set of products and raise them on another without changing planned business volumes, while its competitors were put at a disadvantage through the maneuver because of the difference in barriers to entry of peripherals and CPU's.

Following the May, 1971 price cuts associated with the FTP, IBM took no further action to control the peripherals companies until August, 1972. By that time, the PCM companies had begun deliveries of replacement disks for the high performance 3330 system on the 370 machines, and replacement memory for the larger 370 models. In order to prevent a recurrance of the 360 problems on the 370, IBM prepared a set of price and product revisions, designated the SMASH program, which were announced on August 2, 1972.

The 3330 was initially announced in June, 1970 as part of the 370 announcement. The system consisted of a 3830 controller (which rented for $2400 per month) which could handle up to four two-drive 3330's which rented for $1300 per month for two drives. The smallest configuration available cost a total of $3700 (controller and one two-drive box) and gave the user 200 million bytes of capacity, equal to seven drives on the 2314. If a user needed more than eight drives, a second controller was necessary. In August, 1972, the 3830 controller was withdrawn from the market and replaced by the 3830 II. The 3830 II was similar to the 3830 except that it could control up to sixteen drives instead of eight, and part of the control electronics was missing. The missing part was put into a modified 3330 box, called the 3333. The user needed one 3333 box to go with each eight drives; the minimum system would be one 3830 II controller and one 3333 and the maximum system would be one 3830 II, two 3333's, and six 3330's for a total of sixteen drives.

The price of the 3830 II controller was set at $2025 per month ($375 lower than the 3830), the price of the 3333 was set at $1627 per month ($327 higher than the 3330), and the 3330 boxes remained the same price. Thus the total price on a minimum configuration only dropped from $3700 to $3652, a 1.2% decrease. Because of the higher capacity of the 3830 II than the 3830, the cost of a sixteen drive configuration dropped from $15,200 per month to $13,079, a 14% cut. The cuts due to the 3830 II were relatively minor and easily explainable by technological change which allowed a higher capacity controller. However, the 3830 II could also be put under the covers of the CPU. If the 3830 II was put into a 370/135, it was called an Integrated File Adapter (IFA) and rented for $700 per month instead of $2025 if it was in a separate cabinet. If it was put into a 370/145, it was called a Integrated Storage Adapter (ISC) and rented for $1150 per month. If it was put into a 370/158 or 168, it was called an Inboard Director and rented for $2200 per month for two 3830 II's able to control up to thirty-two drives.

A single controller was not available inside the CPU of the 158 or 168. The integrated controllers performed the same function and contained the same circuitry as the 3830 II stand alone unit. The IBM specifications stated: (35) "The Director is packaged in two forms: a. as a second level product for integration into a CPU frame such as the 145, Olympus [158] or Pisces [168] . . . this packaging will be referenced as an IBD (Inboard Director). b. as a model of the 3830."

The low price of the integrated versions of the 3830 II produced substantial price cuts. On the 370/135, the savings for a complete 3330 system ranged from 37% for a two drive minimum system to 23% for a sixteen drive system, compared with the previous 3330 prices. On a 158 or 168, the price actually went up for a two drive configuration because of the requirement that two controllers be purchased. On more normal configurations for the large machines, the cost of a 16 drive system dropped from $15,200 per month to $13,254 per month (12.8%) while the cost of a 32 drive system dropped from $30,400 per month to $24,308 per month (20%).

The 3330 revisions were both a price cut and a product manipulation designed to make competitive attachment more difficult. The integrated controller meant that independents would have to redesign their products to match IBM's interface between drives and controllers rather than replacing both drives and controllers as a unit. The changed interface between drives and controller through putting control electronics with one of the drives meant that if an independent had matched IBM's drive-controller interface in anticipation of integration, he would still have to redesign his products to make them compatible. In addition the integration of the controllers allowed IBM to practice price discrimination and tying together of products without it being as obvious as if the products were in separate boxes.

The August, 1972 announcement also culminated a long discussion of how to protect memory from the PCM companies. The first memory competition had come in 1969 from Ampex on the Large Core Storage units for the 360/50 and 65. The LCS was a core memory which was much cheaper and slower than main

memory. In early 1970, the competition was extended to main memories for the 360. At that time, the amount of competition was insignificant and IBM felt that it could profitably avoid taking any action to protect the 360 memory, but was concerned to avoid loss of memory on the 370 machines being prepared for announcement. In April, 1970, T. V. Learson, IBM president, wrote: (36)

"Originally, I advised them to price memories and CPU's both at 30%. They readily agree that CPU's cannot be easily duplicated whereas memories can be easily duplicated on a plug-in basis. I would, therefore, conclude that we should have 25% profit on memories, higher price on CPU's and up [sic] with an overall profit in the 32% range."

As a result of the concern with possible competition, an IBM group was authorized to study the potential profitability of competing with IBM in memory at various IBM prices. Because the primary concern was with new entrants rather than current competition, the study was done both for a hypothetical new company and also for an established company moving into the memory competition business. The analysis showed that IBM's primary protection was the time required for the company to become established. The study assumed that the company would begin planning and hiring in June, 1970 (at the announcement of the initial 370 machines) and would not ship its first memory until July, 1972. Because of the necessity for renting at least part of the memories and the discount required over IBM in order to sell, the new company would not break-even until around 1974 if the IBM price was $16-$18,000 per month per megabyte [one million character capacity] of memory, and until 1976 at $12,000. At IBM prices of $12,000 and above, the summary charts showed good profitability for the company beyond 1976, and at $10,000 and below, no break-even until the far future if at all.

For an established component company, the analysis showed that it could enter memory competition and reach breakeven point by 1973 with an IBM price of $18,000 per month per megabyte, and by 1975 with a price of $10,000–12,000, with high profitability in later years for all prices $12,000 and above. The study concluded that the planned IBM pricing on the 370 ($12,000 per mega byte) left "marginal viability" for a new company, but that established component companies would be likely to enter the field because they could make 20% return on investment for a $10 million investment. (37) The IBM study showed that after the start up period, the PCM companies would make a 23% profit margin at an IBM price of $12,000 per month. (38)

Further IBM studies of potential memory competition showed additional protection. By 1976, IBM expected to have $61 million per month rental value of memories on 370 machines. Of this total, IBM estimated that 26% was protected through minimum memory sizes allowed with machines, 36% through customers who would resist a mix of IBM and independent equipment, and 15% because it was in low density geographical areas where the independents were not expected to compete. This left only 23% of the memory as a possible target for the independents regardless of the exact price set by IBM. An IBM memo just before the final pricing decision on the initial 370 models states: (40)

"Memory OEM studies indicate not much concern over new small companies starting up—either ferrite or monolithic; considerable (and, I believe, proper) concern over established components manufacturers such as TI, Motorola, Fairchild, etc. Their estimated 23% penetration by end of 1976 is limited primarily by market factors and not significantly by IBM slopes of $5, 6 or 7K. [5K slope in this context is $5,000 per month per 512,000 bytes of memory, or $10,000 per megabyte] if we assume that the proposed system prices are correct, (which are based on $6K slope), then any change in slope should be offset in the CPU prices. I would rather have the profit in the CPU and would thus be against a $7K slope. The $5K slope produces certain gaps in the structure of the line. Therefore, I recommend we go with the $6K slope.

The exposure that the M9 memories [370/155 and 165 memories] might face massive FET replacement in 1974 appears impossible. Even CD's schedule would not permit significant shipment until 1975."

Based on the estimated lag between IBM introduction and competitive shipments and the expected customer resistance to competitive memory, IBM adopted the price of $12,000 per month per megabyte for the memory on the 370/155 and 165, announced June 30, 1970. The 370/155 and 165 memories were magnetic cores, the standard computer memory component since the first generation. The 370/145 introduced an all semiconductor memory, referred to by IBM as phase 2i or bipolar technology. It was much faster than the existing core mem-

ories and was not considered immediately subject to competitive attack. The price was set as $9600 per month per 512,000 bytes, a 60% increase by byte over the core memory price of the 155 and 165. The memory technology was expensive for IBM to develop and the relatively high price for 145 memory still only yielded a 26% profit margin on memory, below IBM's target of 30%.

By the time of the 370/135 announcement in March, 1971, IBM was beginning to be concerned about competitive replacement of semiconductor memory as well as the core memory on the 155 and 165 models. However, because the 135 used the same technology as the 145, the company felt constrained to change the same price in order to have a rational pricing pattern. The 370/135 analysis stated: "Memory sizes installed on the M135 are partially a function of projected PCM memory penetrations. While it was assumed the PCM impact could occur from the 96K model on up, Forecasting's understanding of this recent PCM phenomenon was still based on limited data, much judgment and wide confidence limits."(41) Given the memory price determined by the 145, IBM could only vary the price of the CPU. A low CPU price generated maximum systems installed and thus the maximum demand for memory and input-output equipment (subject to replacement by PCM's) while the higher price on the CPU increased CPU profit but reduced demand for peripherals. The solution found to the dilemna was to bundle a large amount of memory with the CPU and charge the lower CPU price. This had the advantage of maximizing overall profits while protecting at least the bundled portion of memory from competition. The 370/135 analysis stated: (42)

"The more risky and vulnerable parts of the system, due to PCM, were the memory and the I/O. Since their contribution to overall profit was most directly related to CPU quantity, a higher CPU price would result in less quantity and thus less memory and I/O dependency. The tradeoff then was whether to put price into the CPU to achieve profit from it instead of from large quantities of memory and I/O obtained with a low price (and profit) on the CPU.

While Finance favored the higher CPU price, lower quantity rationale, the MRC had a third way of looking at the problem. They felt that raising the M135's minimum entry model from 72K to 96K of memory made strategic sense without losing the company many orders—either the customer needed 96K to run his applications, diagnostics, etc., or he would accept a T55 [370/125] instead. To make the 96K model easier to afford and ensure a minimum loss of acceptances, the MRC decided to lower the price level of the CPU by $300."

At the time of the 370/135 announcement, IBM was beginning to see that its previous forecasts had underestimated the ability of PCM's to deliver replacement memories, particularly for the core based 155 and 165. A task group was set up to study alternatives for reducing the threat. Basically, the plans considered were various combinations of minimum memories and reduced memory prices combined with increased CPU prices. An extreme case involved abandoning the concept of variable amounts of memory and introducing more models each with a fixed memory size. The reduction in memory options would protect the memory market because IBM would refuse to sell a CPU without the minimum memory, and at that time it was thought to be difficult or impossible to install memory beyond the IBM specified maximum for the machine model involved. The various potential strategies were considered risky because of the possibility of an antitrust suit over tying memory to CPU's and of the IBM credibility problem that would be raised if the company introduced replacement machines right after the old ones had been delivered. B. M. Hochfeld, a member of the task force, wrote in March, 1971: (43)

"I cannot think of a good rationale for drastically increasing memory minimums to provide a very limited performance increment . . . restricting PCMs from 60-70% of their market without price competition would almost certainly provoke legal consequences and I wonder what contingency I can provide against a civil triple damage suit . . .

"Furthermore, the loss of systems seems very likely to exceed gains from PCMs. For example, a two megabyte 165 excludes one third of the potential market at that level and many of these customers are likely to be captured by competition.

"In addition, our purchase customers are likely to be sorely tried by our obsoleting of their equipment within eighteen months of acceptance. Their realization that IBM sold them dead-end equipment with no Advanced Function capability and no new programming is not likely to endear this customer group to us and will present some complex problems to our salesmen."

While Hochfeld was unconvinced of the wisdom of tying memory to CPU's, he did feel that IBM ought to price the memory low enough to discourage competitors. He wrote: (44)

"Furthermore, when you deal in monolithic memory, either CP or HMS, where many of the larger potential competitors such as T. I. Fairchild have not yet entered the market, it seems clear that their judgment on entry will be significantly influenced by our pricing.

". . . We would want to be quite sure that the impact of a price cut on PCMs is properly identified so that a valid financial analysis can be made."

On July 15, 1971, the Data Processing Group presented its recommendations for memory protection to the Management Review Committee. The final recommendations included pricing action and minimum memory but without actually withdrawing the old machines and introducing new ones as had been considered.

The Group recommnened increasing the rental and purchase price of the 370 CPU's by 13–23%, while reducing the price of the various 370 memories by 27–43%. In addition, minimum memory sizes would be imposed ranging from 256,000 bytes on the 135 (compared with 96,000 bytes at announcement three months earlier) to two megabytes on the 165. (45) The Management Review Committee rejected the Group's recommendations "on the basis that pricing actions involving rental increases of more than 5–6% would be an irrational business move." After further consideration, the Group reported back that "any plan formulated within paramters outlined by MRC is inadequate to meet objectives." After further discussion and consideration of various alternatives, the "MRC concluded that any rental reductions at levels permissible to good business judgment should be excluded on the basis of their minimal contribution to strategic objectives when balanced against their undesirable revenue effect." The final decision was to raise the CPU prices by no more than 8%, cut the purchase price of the 155–165 memory, and make no change to the rental price. (46) No combination of actions could be found that would stop the competition in memory and still be justified by IBM as anything other than an attempt to stop the competition in memory.

IBM's plan for the 370 included core memories for the 155 and 165, semiconductor memories using phase 2i or bipolar technology for the 135 and 145, and semiconductor memories using FET (field effect transistor) technology for the 125. The FET technology was cheaper than the bipolar but was not expected to be available until 1975 in quantity. With improvements in memory technology by competitors, IBM accelerated its FET program to the point where FET memory could be delivered in 1973. (47) The 155 and 165 Greybooks (extensive analysis of the machine, market, and strategy prepared for each major product) prepared at the end of 1970 (after announcement but before delivery of the machines) showed that both machines would be upgraded with semiconductor memory and virtual memory ("relocate") capability during their lifetimes. The memory enhancements were scheduled for delivery in January, 1974, with relocate to follow in June, 1974. The initial assumption was that relocate would be fitted retroactively to previously delivered machines. The 165 Greybook stated: "The relocate and multiprocessing features were assumed to be available to all customers equally. Thus, customers who purchased early systems requiring extensive engineering changes to accomplish this feature attachment will not pay a premium price." (48).

With the rapidly growing threat to memory during 1971, IBM abandoned the idea of upgrading the 155 and 165 and revived the strategy of introducing the upgraded 155 and 165 as new machines with higher CPU prices and lower memory prices. By delaying the introduction of virtual memory, IBM could combine the virtual storage and semiconductor memory announcements. It could then justify the higher CPU price through increased performance and the lower memory price through the reduced manufacturing costs of semiconductor memory.

Besides price, the FET memory had many features which increased the problems of a potential replacement company. A late 1971 IBM engineering study of the potential methods a PCM company might use to attach memory to the IBM CPU concluded that "the ability for competition to add to our minimum FET memory configurations is a very large and maybe even an impossible task." (49) The primary difficulty compared with core additions was that core memory was in a separate box while the FET memory was inside the CPU sharing power with other units. The CPU was so designed that if the competitor tried to attach a separate box of memory, it would need to make changes in IBM's CPU

logic. If the competitor tried to replace IBM's memory cards directly, he faced major problems because of differences between IBM specifications and standard industry practice, and secret interface specifications and cable connections which would not be published or sold. The study concluded: "In short, we may be overreacting in our assumptions to reduce the $12K slope."(50) (to reduce the FET memory price below the $12,000 per month per megabyte on the 155 and 165 core memory). In order to avoid losing money on a needless price cut, IBM set up the Kenyon House Task Force to evaluate the conclusions of the engineering study and reconsider the need for a price cut. The task force concluded that the technological difficulties of adding to FET memories could be overcome and the only solution to competition was to lower price enough to prevent entry.

As a result of the studies, IBM announced the new versions of the 155 and 165 as the 158 and 168 on August 2, 1972, as part of the SMASH announcement. The basic CPU price was raised 36% on the 165 (from $35,640 per month on the 165 to $48,600 per month on the 168) and 54% on the 155 (from $19,980 per month on the 155 to $30,700 per month on the 158). The memory price was cut 57% from $12,000 per month per megabyte to $5200 per month per megabyte. In addition, a minimum of one half megabyte on the 155 and one megabyte on the 165 was tied to the basic CPU; IBM would not sell or rent the CPU alone. The drastic increases in CPU price and decreases in memory price meant that the total price of the new machines was higher in small configurations and lower in large configurations than the original machines. The semiconductor memory was not made available to the original 155 and 165, prohibiting customers from buying the cheaper CPU and putting on the cheaper memory as well. The relocate feature was made available, but at a high cost, $200,000 for the 155 and $400,000 for the 165.(51)

There is some dispute as to whether or not IBM calculated the $5200 price for memory as the price that would drive all competitors out of business. IBM analyst B. M. Hochfeld testified at the IBM–Telex trial (after leaving IBM) that he viewed the $5200 price as low enough to prevent competition from entering the 158–168 memory market.(52) However, IBM introduced charts showing that the Kenyon House task force had concluded that companies could be viable selling FET memory at $3000 per megabyte per month, enough to allow a 42% discount over IBM's price.(53) Many industry observers assumed that the prices were designed to eliminate competition. R. A. McLaughlin, associate editor of Datamation wrote soon after the announcement: "This kind of pricing can't do very much for IBM revenues, but it may drive independent memory suppliers * * * from several weeks before the announcement, because the substance of the announcement was revealed early through a Telex court attempt to prevent it from being made. From July 6, 1972 to August 3, 1972 (the SMASH announcement was made August 2), Memorex stock dropped 31% while Telex stock dropped 28%. Memory maker Advanced Memory Systems dropped 25% in the same period. Because of the early retirement of the 155 and 165, the move was also a blow to leasing companies who purchased the machines. Computer lessors DPF dropped 22% and CIG dropped 11% over the July 6–August 3 period.

The SMASH announcement was IBM's last significant move against the PCM companies to date. The new products and prices announced August 2 combined with previous actions effectively stopped plug compatible competition on the 370 machines. Some efforts continued but not enough to be a threat to IBM's revenue. The focus of the PCM companies returned to the 360, where significant enhancements were made by providing more and faster memory and other peripherals than allowed by IBM, as well as cutting below IBM's prices. Enough 360's remain installed at present to provide a large market, but it is a deadend business unless some way is found to add on to the new machines. The 360's with PCM core and peripherals are enough more powerful than the original 360's to replace some 370 sales but the limited number of machines available has made this a relatively unimportant problem for IBM.

The 1970-1972 war between IBM and the PCM companies has been examined in detail because it is an unusually clear example of a pure profit maximizer taking advantage of the structural characteristics of the industry. If only the record of price and product actions were available, as is generally the case in industry studies, we could only say that IBM's actions were consistent with the profit maximization hypothesis given the structure of the industry. However, because of the documents revealed in the Telex-IBM antitrust case, we can see the information available to the decision makers at the time and the way they

analyzed it. This allows the unequivocal conclusion that IBM was practicing a very spohisticated form of profit maximization which included explicit evaluation of the effects of its actions on current companies and potential entrants.

The basic structural characteristics that are important for understanding IBM's actions are that there are high barriers to entry in the entire systems market, but low barriers to entry in the peripherals market. The barriers that do exist in the peripherals market are primarily related to brand loyalty to IBM (including a fear of a mixed supplier installation) and the difficulty of producing exactly compatible products which will match the IBM interface specifications. The latter problem causes a time lag between the time of IBM introduction of a product and the time it can be copied. This time lag reduces the rental life of the competitive product and gives IBM some time after a new product introduction without competition. Additional barriers to entry in the peripheral market include the need for capital to finance a rental business and some economies of scale which give IBM a manufacturing advantage. It is important to note that the economies of scale are small enough that the PCM companies could make a satisfactory profit while undercutting IBM's existing price before IBM took explicit action against them.

In any situation where a company possesses substantial market power in one product and less market power in a complementary product, the best policy for profit maximization is to tie the products together, refusing to sell the one without the other. If the products are totally tied together, the company can choose the prices for each combination to optimize profit. However, tying products together is illegal under the antitrust laws if it expands market power. A less effective alternative is to increase the price of the product with barriers to entry and price the product without barriers to entry at a competitive price. This reduces the possibilities for price discrimination among various classes of users. For example, if the CPU is priced high enough to gain as much revenue from the intensive user with low peripherals prices as would be gained with a balance of peripherals and CPU prices, then it is likely to be high enough to drive the less intensive user out of the market because he is not compensated by the lower peripherals prices.

IBM pursued a combination of both strategies, tying products together where it could be technically justified, and raising CPU prices while reducing peripherals prices where tying could not be defended legally. The integration of controllers (IFA for the 2319 and ISC for the 3330), and the bundling of minimum memory with the CPU were attempts to tie the market for peripherals and CPU's together. The FTP on peripherals with its substantial price cut followed by increases in CPU prices, and the 158–168 with substantially increased CPU prices and reduced memory prices were reallocations of the revenue between CPU's and peripherals to take account of the fact that IBM no longer had substantial market power in peripherals.

A second aspect of market structure is the disruption caused by equipment installation and removal, even when compatibility is not a problem. This means that extra revenue can be obtained when a price cut is necessary by requiring an equipment exchange to take advantage of the price cut. This tactic was used effectively with both the 2314 disk drive and the 2420–7 tape drive. In both cases IBM needed to make price cuts in order to remain competitive. In both cases, the price cut products were introduced as new products with identical performance specifications, the 2314 as the 2319 and the 2420–7 as * * * involved, as well as lack of information or lethargy on the part of some computer managers, allowed IBM to have a competitively low price product while still receiving the higher rent from many customers for some time after the price cut.

The third structural characteristic that IBM took advantage of was the necessary time lag between IBM introduction of a product and PCM introduction of a replacement. In the early days of PCM competition, IBM overestimated this lag and erroneously felt that it would make the PCM competition a minimal threat. Later, IBM introduced the fixed term plan and more rapid minor product changes in order to capitalize on the time lag. When a new product was introduced, customers had little incentive not to accept it on the fixed term plan because no competitive replacement was ready. The heavy penalties for early termination under the FTP effectively reduced the PCM's prospects to those customers finishing a lease. By making changes to the products rapidly (such as switching control functions between drives and control units), IBM was able to further reduce the PCM's marketing effectiveness without reducing prices.

Summary of Product Characteristics

DISKS DRIVES

2311 Primary direct access storage devices for small scale 360 users, each drive can access seven million bytes (characters) of data, transfers data at 156,000 bytes/second.

2314 Primary direct access storage device for large scale 360 users, each drive can access 29 million bytes of data, transfers data at 312,000 bytes/second, must be used with a 2314 controller which can control up to eight drives.

2319A Three 2314 drives put together in a single box, attaches to an integrated file adapter on the 370 instead of a 2314 controller.

2319B Same as 2319A except it attaches to a modified 2314 controller for use on the 360 machines instead of only with the integrated file adapter.

3330 Primary direct access storage device for large scale 370 users, each drive can access 100 million bytes of data, transfers data at 800,000 bytes/second, originally used with a 3830 controller which could control up to eight drives.

3333 3330 with some of the controller electronics contained in the same unit.

3830 Control unit for the 3330.

3830 II Control unit for the 3330 after August, 1972, controls up to 16 drives, must be used with a 3333.

TAPE DRIVES

729 Family of second generation tape drives, also used with the 360.

2401 Main family of tape drives used with the 360, included six models ranging from the 2401–1 which recorded data at a density of 800 bytes/inch and transferred data at 30,000 bytes/second to the 2401–6 which recorded at 1600 bytes/inch and transferred data at 180,000 bytes/second.

2420 New family of tape drives announced in 1968 for use with late 360's and 370's, included 2420–5 which transferred data at 160,000 bytes/second and the 2420–7 which transferred at 320,000 bytes/second.

3420 A slight revision of the 2420 family announced in 1970, the 3420–5 and 3420–7 are identical in performance to 2420–5 and 2420–7.

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Exhibit 3.—*Paper by Gerald Brock Re Structural Reorganization of Computer Industry*

STRUCTURAL REORGANIZATION OF THE COMPUTER INDUSTRY: AN ECONOMIC ANALYSIS

By Gerald Brock, Assistant Professor of Economics, University of Arizona, February 22, 1974

[NOTE.—This paper was prepared for use of the Subcommittee on Antitrust and Monopoly under a contract between the author and the Committee on the Judiciary of the United States Senate. It is not to be construed as the statement or position of the committee or any member thereof.]

SUMMARY

This paper first reviews the known relationships between an industry's structure and its economic performance. These studies indicate that barriers to the entry of new firms into an industry is a greater cause of poor economic per-

formance than high concentration. The structure of the computer is then reviewed, showing that the industry is highly concentrated with one firm controlling about 70% of the market, and that barriers to entry are extremely high. The weaknesses that exist in the performance of the industry are shown to be a result of barriers to entry. Consequently, in order to optimize economic performance, the proposed reorganization is designed to reduce barriers to entry while avoiding either disruption of current customers or losses in the efficiency of operations.

The proposed reorganization is to split IBM into four companies: (1) a peripheral company containing all of IBM's production and research facilities related to peripheral equipment, (2) a maintenance company containing all of IBM's maintenance personnel, (3) a marketing, leasing, and consulting company containing all of IBM's marketing personnel and consulting and application programming capability, (4) a central processing unit company which would produce CPU's and system control programming. Discussion of the proposed new companies indicates how barriers to entry would be reduced and examines potential problems that could arise with the proposed reorganization.

I. Background Economics

In considering the possible reorganization of the computer industry, one of the first questions is what economic science can tell us about the relationships between an industry's structure and its economic performance. The confidence with which the structure-performance links can be predicted is also a measure of the confidence with which we can prescribe structural reorganization as the cure for performance problems. If the structure-performance links are weak or unpredictable then we cannot be sure what the results of any particular reorganization will be; if they are strong and regular, we can predict with confidence the economic results of any proposed reorganization of the industry.

Economic theory gives the most definitive results for highly simplified market structures such as perfect competition or pure monopoly. The computer industry, as with most major U.S. industries, can be classified as an oligopoly. Theoretical results relating oligopoly structure to an industry's economic performance are very weak because of the many possible variations in oligopoly behavior. Although economic theory cannot provide definitive relations between variations in the structure of an oligopoly and variations in its performance, the theory can be used as a guide for gathering and analyzing data to formulate the structure-performance links empirically.

Economic theory tells us that the conduct of an industry (price and product strategy, research and innovation, advertising level, attempts to coordinate actions with other firms in the industry) should be a function of the industry's structure (number and size distribution of firms and barriers to entry). With low concentration and low barriers to entry, the industry's conduct should approach that of a competitive industry, while with high concentration and high barriers to entry, the conduct should approach that of monopoly. Structure and conduct together should determine the economic performance of the industry (allocative efficiency, effects on income distribution, and progressiveness or technological innovation).[1]

Precise definition of the interrelationships among the variables mentioned above would obviously be extremely useful to antitrust questions. If a reliable statistical estimate of the structure-conduct-performance links existed, then we would predict the results of any proposed reorganization of an industry or restrictions on its competitive analysis of the industry in question. Three problems stand in the way of developing such an equation. The first is that of quantifying the variables. In quantifying a variable such as "number and size distribution of firms", one must use a measure such as the concentration ratio (the percentage of the industry controlled by the largest four firms). This measure causes an industry such as automobiles to appear more concentrated than the computer industry because it combines the influences of number of firms and relative sizes of firms. Brand loyalty is a significant component of barriers to entry but can only be quantified by such measures as the advertising/sales ratio or a subjective index compiled by the researcher.[2]

[1] For an extensive study of structure-conduct-performance interrelationships, see F. M. Scherer, "Industrial Market Structure and Economic Performance" (Chicago: Rand McNally & Company, 1970).

[2] For a study of barriers to entry and the problems in measuring them, see Joe S. Bain, "Barriers to New Competition" (Cambridge: Harvard University Press, 1956).

The second problem is that of data. The data necessary is closely held by the corporations involved. Most of the studies that have been done have used Census Bureau data which is aggregated and classified in such a way as to protect the confidentiality of the companies. However, the aggregation also clouds the economic significance of the statistics.

The third problem is that the structure-conduct-performance links can only be expected to be true in a statisitical sense and not in every individual case. Structure is an important determinant of pricing policy but the industry's history and product peculiarities also play a role. Consequently, even with perfect quantification of the variables and perfect data, we should still expect a substantial amount of unexplained variance in statistical studies of structure-conduct-performance links.

Because of data and classification problems, some of the best research has used simple classification schemes rather than formal statistical methods to illustrate the relationships. Very significant results were found in Michael Mann's study of the average rates of return after taxes on the stockholder's equity for thirty industries in the years 1950–1960. The result are shown in Table 1.

TABLE 1.—PROFIT RATES BY CONCENTRATION AND BARRIERS TO ENTRY

	Very high barriers	Substantial barriers	Moderate to low barriers
High concentration	16 4 (8)	11-1 (8)	11-9 (5)
Moderate concentration	(0)	12–2 (1)	8–6 (8)

Note: The number in parentheses is the number of industries in each category.

Source: H. Michael Mann, "Seller, Concentration, Barriers to Entry, and Rates of Return in 30 Industries, 1950–60," Review of Economics and Statistics, XLVIII (August 1966), 296–307.

A measure of performance for the industries is the deviation of the profit rates from the average profit rates in the economy. Short term fluctuations in profit rates are signals to investors to increase or decrease investment in certain industries, but long lasting deviations from normal profit levels are indications of poor performance. Prices in industries with abnormally high profit levels are higher than the price necessary to bring forth the needed production, and consequently the economy is not allocating scarce resources among competing projects as efficiently as possible. Also, a sustained high profit rate causes a redistribution of income from consumers to stockholders compared to what would occur under competitive conditions.

The average profit rate after tax on stockholder equity for all U.S. manufacturing corporations for the years 1946–1965 was 9.0%.[3] Using this figure as a cost of capital, the Mann figures show that industries with high concentration and very high barriers to entry had returns 82% above what was required, an indicator of poor performance. Those with substantial entry barriers had profit rates 24% above the normal, and those with moderate to low entry barriers had profit rates 24% above the normal, and those with moderate to low entry barriers had profit rates approximately equal to what was required. Although the Mann study shows the general magnitude of profit variations with concentration and barriers to entry, it could not identify the separate effects of concentration and barriers to entry because no industries were found with very high barriers to entry and moderate or low concentration.

Many studies have been done using multiple regression techniques to relate various measures of strructure to profit rates. Among the best of these is one done by Comanor and Wilson using forty-one consumer goods industries.[4] Structural measures used for explanatory variables included the advertising/sales ratio and advertising per firm (representing product differentiation or brand loyalty as a barrier to entry), economies of scale, capital requirements, and two measures of concentration. The most significant explanatory variables (statistically significant at the 1% confidence level) were the advertising/sales ratio and capital requirements, both measures of barriers to entry. Although the Comanor and Wilson equations showed an increase in profit rates from an in-

[3] Lawrence J. White, "The Automobile Industry Since 1945" (Cambridge: Harvard University Press, 1971), p. 251.

[4] William S. Comanor and Thomas A. Wilson, "Advertising Market Structure and Performance," Review of Economics and Statistics XLIX (Nov. 1967), pp. 423–440.

crease in concentration without changing barriers to entry, the rate of increase calculated was not statistically significant. The difficulty in measuring the separate effects of concentration and barriers to entry arises because the two variables tend to rise and fall together, so that too few observations are available on their separate influences to estimate them with confidence. The Comanor and Wilson equations explained 46% of the variance in profit rates for the industries studied.

Although the separate influences of concentration and barriers to entry cannot be estimated statistically, they can be identified through economic reasoning. A highly concentrated industry can coordinate its pricing actions relatively easily to raise prices above the competitive level. However, if barriers to entry are low or nonexistant, the high profits made will be eliminated as new firms enter the industry. The potential competitors keep prices down almost as effectively as actual competitors in the industry. The potential competitors are not totally effective because some difficulties always exist for new entrants and there is a time lag between the time a corporation decides to enter an industry and the time it achieves full production. Consequently, we expect to see higher profits in highly concentrated industries than non-concentrated ones of the same barriers to entry, but the profits can never rise very far above the competitive level over a long period of time in the absence of barriers to entry. An industry with high barriers to entry and very low concentration also could not raise profits very far above the competitive level because of the difficulties of coordinating prices and avoiding price wars. However, no such industries exist or are likely to exist. If entry is blockaded, there is much more incentive for the strongest firms to expand their market shares than if entry is free, which eventually leads to concentrated industries.

The above conclusions suggest that barriers to entry rather than concentration should be the primary concern of antitrust policy. If an industry's entry barriers can be reduced, it will evolve toward competitive performance naturally without the necessity for governmental intervention to reduce concentration. Conversely, if firms are split to reduce concentration but entry barriers remain high, the industry will naturally evolve back to monopolistic behavior. Of course, the best way to restore competitive behavior is to reduce both concentration and barriers to entry, but in many cases direct deconcentration could lead to disruption and inefficiency for both the manufacturer and the customer.

Because the statistical studies do not account for all the variance in profit rates, it is necessary to make a complete study of the computer industry to determine how closely it conforms to the expected patterns in order to determine what reorganization is necessary. It is also necessary to study the industry for information on how structural change would affect technological progress. Statistical results on structure-progress links are extremely poor and sometimes contradictory, a result of the problems of quantifying progress and the opportunities for progress. And finally, it is necessary to examine the industry to determine the source and extent of barriers to entry, and to determine what could be done to reduce those entry barriers.

II. COMPUTER INDUSTRY CHARACTERISTICS

This section summarizes the structure, conduct, and performance of the computer industry, emphasizing the aspects of the industry that are relevant to the problems of reorganization. It is based upon information developed in an extensive study of the industry by the author.[5]

Before defining the market shares held by various firms in the industry, it is necessary to define the industry. There is no definitive economic answer to the industry definition question. An industry should include all products which are close substitutes for each other and exclude products which are not good substitutes for others in the group. Because of the varying degrees of substitution among different products, it is necessary to choose definitions that relate to the specific problem wtih which one is concerned. A meaningful definition of the industry which is suitable for this study is general purpose computers and their associated perpheral equipment. This definition excludes analog computers, special purpose computers, and data entry devices such as keypunch machines and terminals. The logic behind this definition is that we should include computer

[5] For expansion and clarification of the points mentioned here see Gerald Brock, "The United States Computer Industry 1956–1973," (unpublished Ph. D. dissertation, Harvard University, 1973).

systems which are generally in competition with each other and also the equipment which must be used with a particular CPU design or set of interface specifications.

TABLE 2.—MARKET SHARES

[Percent]

Year	IBM	IBM (internal)	Next largest firm	Top 4 firms
1956	73.1		21.3	98.3
1958	71.2		20.8	97.3
1960	70.7		20.0	95.0
1962	70.4		11.6	87.5
1963	74.5		8.3	89.4
1964	72.5	75.9	9.0	88.5
1965	66.7	74.8	9.2	85.2
1966	69.7	74.2	7.8	87.4
1967	74.3	74.3	6.3	88.9
1968	74.6	73.3	5.6	88.2
1970	70.6		7.3	86.1
1971	67.4		7.7	87.1

Source: IBM internal figures taken from IBM Quarterly Product Line Assessment, November 1968, p. 13. Other figures calculated by author from data on computer installations in the Diebold Automatic Data Processing Newsletter and the "Monthly Computer Census" of Computers and Automation.

Table 2 shows the market shares of IBM, the next largest company, and the top four companies together for various years. All figures are based on installed machines during a given year, rather than new sales for that year. Because computers are a capital good, the proper measure of market share is the stock of capital installed rather than the changes to that stock. So long as market shares remain approximately constant, the stock and sales market share figures will be approximately the same. The major computer companies consider their installation figures proprietary; consequently the calculations are based on estimates by industry authorities of the installations of each model of computer in each year. Confirmation for the general range of the market share figures is provided by IBM's own estimates of its market share for "systems and peripherals" as shown in the second column.

An analysis of the calculated market share figures shows that IBM's market share generally rises with the introduction of a new product line and falls at the end of the line, but has averaged around 70%. IBM's share hit its high points in 1963 (at the peak of second generation installations such as the 1401 and 7090) and 1968 (at the peak of third generation machines, primarily the System 360). Low points were reached in 1965 and 1971. The IBM internal figures confirm the level of IBM's market share but not the pattern of market share changes. While the calculated figures indicate a rise in IBM share from 72.5% in 1964 to 74.6% in 1968, the IBM internal figures show a drop in share from 75.9% to 73.3% over the same time period.

Through 1968, the second largest firm by dollar value of installed machines was the Univac division of Sperry Rand Corporation. Univac's market share dropped steadily from 21.3% in 1956 to 5.6% in 1968. After 1962, no company other than IBM held over 10% of the market in any year. The market pattern became one dominant firm (IBM with 70% of the market), seven major competitors (Univac, Honeywell, Control Data, G.E., Burroughs, N.C.R., and R.C.A. with two to eight per cent apiece), and a number of minor firms with less than 1% of the market each. Concentration in the industry as expressed by the combined market share of the largest four firms declined steadily as Univac lost ground and firms below the top four gained share. Measured by the four firm concentration ratio, the computer industry is less concentrated than several other industries such as automobiles, primary aluminum, and flat glass, but no other non-regulated major industry is so dominated by one firm as the computer industry.

Barriers to entry in the computer industry can be separated into economies of scale, product differentiation, and capital costs. Economies of scale form a barrier to entry because a new entrant must either suffer higher costs than the established companies or enter at a sufficiently large scale to take advantage of the economies of scale, with a consequent probability of causing a decline in industry price either through excess production or retaliation by the other firms. To study economies of scale, the production of computer systems can be divided into three

categories, manufacturing, sales and maintenance, and design and software, each with different characteristics.

Manufacturing economies of scale are negligible. A study by IBM of its costs of manufacturing peripheral equipment versus those of competitors concluded: "OEM costs are strikingly more similar than different from IBM" and "OEM can match our manufacturing costs".[6] The same study reported that IBM had a 15% cost advantage as a result of its circuit production. However, the advantage did not extend to all circuits. A report to IBM's Management Review Committee stated: "in certain areas like T²L in which costs are relatively independent of volume, competition is estimated to have as much as 30% cost advantage." [7] On the Aspen tape drive (IBM 2420–5), IBM's studies showed its direct manufacturing costs as $4507 compared with $4950 for competitive versions of the product. The $443 difference represents an advantage for IBM of 9.8% of the direct cost or 1.8% of the $25,200 selling price. On the 2314 disc subsystem, IBM's direct costs were given as $24,737 compared with competitor's $30,660, a $5923 difference representing a 24% difference on the direct costs and 2.5% difference on the $237,105 purchase price.[8] Because the independents were producing at very small scales and IBM was producing at a very large scale, the IBM cost advantages indicate moderate economies of scale. However, part of the difference is accounted for by the superior performance specifications of the independent product reducing the significance of economies of scale in manufacturing to an unimportant barrier to entry.

Sales and maintenance are classified together because they have similar economies of scale characteristics. Both activities are performed by labor with very little capital equipment. Consequently, there are no economies of scale of the traditional type arising from the indivisibility of high volume capital machinery. However, there is some advantage to the larger firm because of a reduction in travel time, increasing the productivity of salesmen and maintenance engineers and reducing the customer wait time for service. Because of the critical nature of computer equipment availability, a small company may find it necessary to hire an inefficiently large number of maintenance men to be sure one is on duty near enough to each installation to respond to a problem with the necessary speed. The economies of scale due to travel time are minor in densely populated metropolitan areas, but can become a significant problem for a new company trying to expand into small and medium size cities and towns. As a result, sales of IBM's smaller competitors have been largely limited to the major cities.

Design and software both are characterized by high cost for the first unit produced and practically zero cost for additional units. Consequently, the unit cost of production drops with each additional unit produced, making it difficult for a new firm to compete with a large established firm. Design and software together account for 20% of the total cost of producing a computer system according to a survey of computer manufacturers.[9] The effective marginal cost is substantially greater than zero in software and design because of the difficulty of designing machines or writing software for a large market. The market is not made up of homogeneous users causing software to incur a marginal cost from the extra work required to make it general enough to serve a variety of needs. General software also requires more computer time in overhead than software specialized for the individual user or similar group of users. In some cases this overhead cost is great enough to justify the writing of modifications or additions to the manufacturer supplied operating system to be paid for strictly by the savings in computer time. Although data is not available to adequately evaluate the net advantage to the largest firm from software economies of scale, it appears that IBM's major competitors have been able to produce adequate software without prohibitive costs, suggesting that the software advantages of the largest firm are not insurmountable.

Two factors account for the existence of product differentiation or brand loyalty as a barrier to entry: the difficulty of making rational computer selections and the cost to the customer of switching among computer manufacturers. Selec-

[6] Plaintiff's Exhibit 25, p. 25, in Telex vs. IBM. Case No. 72–C–18 and 72–C–89 in U.S. District Court for the Northern District of Oklahoma, later reference cited as Telex vs. IBM.

[7] IBM, "Management Committee to Management Review Committee Report," October 25, 1971. Plaintiff's Exhibit 391A–142 in Telex vs. IBM.

[8] IBM, H. E. Cooley Presentation to G. B. Beitzel, June 24, 1970, Plaintiff's Exhibit 40 in Telex vs. IBM.

[9] Software was reported as 16% of cost and engineering effort as 4%. See Mohammed K. Hamid, "Price and Output Decisions in the Computer Industry," Ph. D. dissertation, University of Iowa, 1966. (Ann Arbor: University Microfilms, Inc.) p. 203.

tion is difficult because of the multi-faceted nature of computer performance as well as uncertainty about future enhancements or the performance of announced but undelivered machines. Computer performance depends upon a variety of different types of internal CPU operations, the speed and characteristics of several kinds of input-output equipment, and upon the performance of the operating system and language compilers. The relative importance of the various factors depends upon the actual job being considered. Consequently, there is no single measure of computer performance that can serve as a valid ranking of the relative performance for all computers except in relation to a single well-defined computing task. The only way to get an exact performance rating for potential computers on a given customer's applications is to actually program all of his applications for each computer and run them under production conditions. The programming effort involved makes this prohibitively expensive for most customers. It is impossible if at least one of the potential computers is not yet in production status or is not available for test runs, a common situation. Decisions for most customers are based upon guesses or estimates about the computer's performance. The methods include rough estimates from the basic performance parameters of the machine (memory access time, tape speed, etc.), published comparisons using typical jobs, simulation studies of performance, and partial benchmarking by programming one or more common jobs of the user.

Because of the impossibility of easily comparing the performance of various computers, managers responsible for computer selection show considerable disagreement as to the criteria that should be used. E. G. Schuster gathered recommendations for computer selection in a hypothetical case from 498 computer managers. Each person in the study was supplied with information about the potential systems, including the price and a presumed certain figure for the amount of time each system required to perform the user's jobs, eliminating the performance uncertainty discussed above. Thus it was possible to make a purely economic decision for this simplified case.

In analysing the results, Schuster found that the current manufacturer was chosen 26 out of 27 times if other factors were equal. If a competitor offered a 20% price discount with equal performance, the current manufacturer was still selected one out of three times. A second generation computer was selected over a third generation one only 17% of the time even when it offered 39% better performance than the current vendor and 10% better than the other competitors with third generation systems. This indicates that computer managers consider being up to date in technology to be significant for its own sake rather than just because newer systems generally either have better performance or are less expensive than older systems. The selections also indicated a preference for extensive support personnel to be supplied by the manufacturer. An increase in support covered by an additional price increase, with an effective price higher than either the present vendor or another competitor, caused the high support company to be chosen 38% of the time, the present vendor 58%, and other competitor 4%.[10]

The most significant finding of the Schuster study was that managers disagree on the proper selection criteria even when confronted with all of the relevant facts under presumed perfect certainty. This is a very unusual result for the selection of a very expensive producer good in which a 10% saving in monthly rental could be more than the salary of a full time selection expert. Faced with uncertainty about the validity of competitors' claims, most managers will remain with their current supplier unless they are extremely dissatisfied with the service received, causing severe difficulties for a new firm trying to attract customers.

The second major cause of brand loyalty is the cost of switching among computer manufacturers. The customer makes a large investment in a data base and programs to perform his applications. The programs and data are specialized to a particular computer system and are often of equal or greater value than the computer hardware. The degree of specialization of programs and data is a measure of customer loyalty to his manufacturer. In the extreme case where all programs and data were totally non-transferable to a competitive machine, even a competitive price of zero could not entice the customer away because the cost of reconstructing programs and data would be greater than the savings in machine rental. The widespread use of higher level programming languages such as Fortran and Cobol which are similar across machine types

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[10] Elmer G. Schuster, "Selective Demand Determinants in the Computer Acquisition Process," Ph. D. dissertation, The American University, 1969 (Ann Arbor: University Microfilms, Inc.), pp. 31–35.

has reduced but not completely eliminated the problem. A potential competitor must still design his system to exactly match the specifications of the supplier whose customers he wishes to attract, or offer subtantially reduced prices to induce the customer to pay the cost of converting. In practice, this means that most manufacturers adopt the practices of IBM in order to remain competitive, allowing computer standards to be manipulated for competitive advantage.[11]

The uncertainty involved in computer selection combined with the cost of switching to a new manufacturer causes brand loyalty to be very strong in the computer systems market, which poses a formidable barrier to entry. However, two segments of the market have largely escaped the influence of brand loyalty. The plug compatible peripheral manufacturers produce identical copies of IBM input-output units except for occassionally improved performance. They generally adopt all IBM standards including interface specifications with the CPU, channel, or controller to which they are attached, and design their products to be compatible with IBM stoftware. Both the switching cost and the uncertainty about performance are eliminated, leaving a clear decision based on price and the customer's degree of confidence that the competitor can perform according to his promises. The minicomputer segment of the market produces relatively simple products which are more easily compared than larger computer systems. The CPU's and peripherals are often sold separately and thus each can be compared with its competition rather than having to compare the entire package. Extremely rapid growth in the minicomputer segment of the market has meant that competition has been primarily for new customers with little emphasis on luring away the established customers of another manufacturer.

High capital requirements form a barrier to entry because of the differential cost of borrowing funds between new and established companies, putting the new company at a competitive disadvantage. Besides the higher cost of capital for a new company, the necessary capital may not be available at all. High capital costs are a particularly important barrier to entry when combined with product differentiation. Product differentiation increases the time between initial production and profitability while the new company tries to overcome the customers' preference for established firms. This both increases the amount of capital necessary (to pay for extensive losses as well as production facilities) and makes it more difficult to raise capital because of the adverse effects on the company's stock price of showing a loss for several years.

In the computer industry, capital requirements are correlated with economies of scale and product differentiation. In the minicomputer and plug compatible peripheral segment of the market where software and product differentiation are of relatively minor importance, the initial capital requirements for entry are extremely low. The two minicomputer leaders, Digital Equipment and Data General, each began with initial capital of under $100,000, and then raised more with public stock offering for expansion. IBM's analysis of a hypothetical new entrant into the plug compatible memory business concluded that a viable company could be established using $75,000 initial capital from the founders, a private placement the second year, and a public stock offering the third year.[12] Although companies in this category may experience difficulty raising needed expansion funds on the stock market from time to time, the capital requirements for entry are so moderate that they cannot be considered a barrier to entry.

In the business systems market, capital requirements are an almost insurmountable barrier to entry. A firm must offer a variety of products including CPU's and a wide range of peripherals, together with extensive software and support to be taken seriously in the business systems market. The necessity of offering many products combined with the economies of scale that exist in software makes a large firm necessary for efficiency. In addition, the new entrant finds a reluctance to buy his product because of the conversion cost and potential disruption to the customer's operation if the new company should fail to deliver as promised or go out of business. Consequently, he must offer large discounts over the established companies in order to attract new business, and incur substantial losses until his reputation is established. Because the total capital costs are dependent upon how long it takes to achieve respectability in

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[11] For a discussion of the problem of computer standards, see Gerald Brock, "Competition, Standards, and Self-Regulation in the Computer Industry," in Caves and Roberts (ed.), "Regulating the Firm" (Washington, D.C.: The Brookings Institution, forthcoming).

[12] IBM, Memorandum of P. C. Vilandre to L. S. Halperin, "Memory Analysis" June 29, 1970, p. 8, Plaintiff's Exhibit 279 in Telex vs. IBM.

the eyes of consumers rather than just the cost of a plant and equipment, no single figure for capital costs can be given. However, a good indication of their magnitude can be gained from the companies who have entered.

RCA seriously entered the computer industry with the RCA 501 in June, 1959 and never achieved sustained profitability. The company took a pre-tax write-off of $490 million on its computer operations after its exit in September, 1971. Robert Sarnoff, RCA chairman, estimated that an additional $500 million investment would have been required to achieve profitability, suggesting total capital requirements of more than a billion dollars over a period of several years for effective entry.[13] Similarly, G.E. entered the industry in July, 1959, with the G.E. 210 and exited (through merger with Honeywell) in 1970 without achieving profitability. G.E.'s actual investment in the computer business is not available but from the market share figures, was probably as large as RCA's. Although Univac brought out the first commercial electronic computer, the company did not achieve sustained profitability until 1966, causing a long term drain on capital to finance production facilities and losses. Assuming the figure of $1 billion for effective entry is of the right order of magnitude, entry is closed to all but the largest established corporations. A new company could not hope to raise that amount of capital, especially if it was showing continuous losses for five or more years, and even a large established corporation would have to be concerned with the impact of an investment of that magnitude on its financial strength.

The analysis of entry barriers is confirmd by the record of entry. Over a hundred firms have entered the computer field in minicomputers and plug compatible peripherals in the last ten years, as well as several hundred more in other easy entry areas such as consulting and programming services, and leasing. In contrast, there have been no major entrants into the business systems market in the same time period. Of the top eight companies in 1973, only Control Data and Digital Equipment were not already in the computer market with vacuum tube computers before 1960, and neither company has a large share of its business in the business systems area. There has been a small amount of entry into the business systems market in recent years through established companies expanding their product line. For example, Xerox Data Systems has moved from a scientific orientation to mixed scientific and business, and Digital Equipment has expanded from minicomputers into business systems, but movements of this sort account for a very tiny fraction of the business systems market.

Business conduct is the focal point of most antitrust investigations and trials. However, from an economic point of view, structure is the more important variable. From analysis of an industry's structure and economic reasoning, one can predict an industry's conduct. Only if an examination of actual conduct reveals substantially different patterns than those predicted do we need to be concerned with conduct as a policy variable. If conduct in the industry follows the expected patterns given the structure, then it is reasonable to expect conduct to change in predictable ways with changes in the industry's structure. If conduct changes are imposed without changing the structure that led to the previous conduct patterns, the firms in the industry will have an incentive to violate the spirit if not the letter of the conduct decree. Consequently, effective conduct changes without structure changes require continuous court or administrative agency supervision, with the attendant possibilities for abuse, mistakes, and the stifling of creative effort. While structural change appears at first sight to be a more drastic interference with the free market than conduct restrictions, in reality structural change causes less interference because after one change the firms are allowed to operate without restrictions.

For purposes of this summary, it is sufficient to state that conduct in the computer industry is in conformity with what would be expected given the industry's structure. Documentation of this fact requires extensive analysis of price and product actions in the industry and is given elsewhere.[14]

Economic performance consists of allocative efficiency, income distribution effects, and progressiveness or technical progress. One measure of allocative inefficiency is the deviation of a firm's long run average profit rate from the cost of capital in the economy. Table 3 shows IBM's profits for the years 1958–1971. The 17.6% return of after tax profit on stockholder equity is slightly higher than the 16.4% average return in industries with high concentration and very high barriers to entry found in the Mann study.[15] This profit rate combined with

[13] W. David Gardner, "Curtain Act at RCA," Datamation XVIII (March, 1972), p. 34–41.
[14] For an analysis of conduct in the computer industry, see Brock, "The United States Computer Industry 1956–1973," pp. 150–363.
[15] Mann, *op. cit.*

IBM's sales level can be shown to cause a loss of approximately $100 million per year to the economy through allocative inefficiency.[16] This is not money received by IBM but pure loss to everyone in the economy because of lower efficiency in the allocation of resources than would exist in a competitive economy. In addition to the pure loss of $100 million, there is a transfer of over $1 billion per year from IBM's customers to IBM before tax profits, compared with the prices that would exist for IBM to earn an average return on stockholder equity. Forty-eight per cent of this transfer goes to the government as corporate profits tax while the remainder is an addition to the wealth of IBM stockholders. Income distribution questions cannot be answered without reference to personal value judgments, but it is unlikely that the transfer of income from computer users to IBM could be considered good performance on the income distribution scale.

TABLE 3.—IBM PROFITS 1958–71

[Dollar amounts in millions]

Year	Stockholder Equity	After tax profit	Profit rate (Percent)	Sales	Year	Stockholder Equity	After tax profit	Profit rate (Percent)	Sales
1958	$720	$126	17.5	$1,172	1965	2,578	476	18.5	3,573
1959	844	141	17.3	1,310	1966	3,323	526	15.8	4,248
1960	973	168	17.3	1,436	1967	3,832	651	17.0	5,343
1961	1,185	207	17.5	1.694	1968	4,569	871	19.1	6,888
1962	1,381	241	17.5	1.925	1969	5.277	934	17.7	7,197
1963	1,592	290	18.2	2.060	1970	5.947	1,018	17.1	7,504
1964	2,254	431	19.1	3,239	1971	6,642	1,078	16.2	8,274

Note: Average profit rate, 17.6.

Source: IBM annual reports.

In order to consider improving the industry's performance in allocative efficiency and income distribution through structural reorganization, it is necessary to be sure that IBM's high profit rate is a result of barriers to entry and not a result of IBM's superior efficiency. The question cannot be answered definitively because of the difficulties of exactly measuring computer performance discussed above. However, three pieces of evidence suggest that the high profits are due to entry barriers and not efficiency. First, in areas where entry barriers are low, IBM has been forced to cut its prices to compete, particularly with plug compatible peripherals. IBM has also taken action to tie its peripheral products to its CPU's and protect them from competition, suggesting that at least in peripherals high profit margins were not a result of superior efficiency. Second, the estimated economies of scale are not great enough to account for the difference between normal manufacturing profits and IBM's profits. And finally, a regression equation relating computer price and performance (as calculated by a weighted average of internal characteristics) shows that IBM computers have a statistically signicant higher price for equivalent performance than non-IBM computers.[17] The statistical result is not definitive in itself because of the variations in software and service provided by the different manufacturers, but it helps to confirm the hypothesis that IBM's profits are not solely a result of efficiency.

Because of the many opportunities for technological progress in the computer industry, progressiveness is a most important criterion of economic performance. If the rapid rate of technical progress that has existed in the industry could be shown to be a result of its concentrated structure, then the relatively poor performance that has existed on the allocative efficiency and income distribution criteria could be accepted as a necessary price for continuing progress. If, on the other hand, progressiveness has been retarded by the industry's structure, then changes need to be made in the structure to improve the performance. An evaluation of progressiveness in the computer industry cannot be made by simply observing that technical progress has been more rapid than in most industries; it is necessary to know how technical progress would have differed with a differing structure. In the absence of an opportunity to directly observe progressiveness in an industry with the same technical opportunities as the computer industry but a different structure, we can substitute observations on the proportions of innovations introduced by firms of varying sizes in the industry.

[16] Brock, "The United States Computer Industry 1956–1973," pp. 426–467.
[17] *Ibid.*, pp. 164–169.

An analysis of many innovations in the industry indicates that nearly all companies have made substantial contributions to technical progress.[18] Although IBM has contributed the most innovations of any single company, its proportion of contributions has been far below its market share. Actual introduction of an innovation requires both the technical ability to produce the product and the market situation that makes it profitable. IBM generally has an advantage in technical ability because of its extensive research labs, but the smaller firms have more incentive to rush an innovation on to the market. A major innovation is one method of overcoming IBM's product reputation advantage because it allows the innovator to offer either a much better product or a much lower price than the proudcts without the innovation. Probably the most important single innovation in the industry was the switch from vacuum tubes to transistors as the basic circuit component. Recognizing a major opportunity, four new companies (Philco, Autonetics, G.E., and RCA) entered the computer industry with transistor computers to market against IBM's vacuum tube models before IBM delivered the transistor 7090 in late 1959. All innovations imply risk taking. It is generally to IBM's advantage to avoid taking the risk of an untried concept. A new company or one trying to expand its market share must take the risk in order to prove the superiority of its products. If the innovation is successful or appears to be a threat to IBM's market position, IBM can usually deliver a competitive product before incurring a substantial loss.

Besides risk, it is in IBM's advantage to avoid taking the lead because of technical standards. For example, even though the IBM 7090 was delivered after the Philco 2000 system for large scale users, the 7090 soon became the dominant machine in that segment of the market through IBM vacuum tube computer upgrades. Consequently, Philco found itself at a disadvantage in competing for upgrades because the Philco 2000 was incompatible with the IBM 7090. IBM was more protected from Philco competition by the incompatibility of the 7090 and 2000 than if IBM had delivered the 7090 earlier and allowed Philco to copy some of its specifications. The same problem exists with the plug compatible peripheral manufacturers. Because they are dependent upon compatibility with IBM, they can make only minor improvements over the announced IBM specifications. Even if the technology is available to them, they cannot make major advances such as the change from 2314 type disc drives to 3330 type drives without waiting for IBM to define the specifications which must be followed.

From the record of innovations in the computer industry, it appears that maximum technical progress occurs with a wide variety of firm sizes. A perfectly competitive industry of very small firms would lack the financial resources for very expensive development work such as complex operating systems. However, domination by one firm also slows progress because of the lack of incentives for that firm to lead in putting innovations into marketable products. An industry with some very small firms to introduce high risk products or innovations passed over by the larger ones, some medium scale firms of the size of IBM's current major competitors to provide sustained technical progress, and possibly some larger firms could be expected to encourage technical progress somewhat more efficiently than the current structure.

III. Proposed Reorganization of the Computer Industry

In considering methods of improving the performance of the computer industry, it is necessary to evaluate the problems leading to poor performance. Two situations can be distinguished. The first is poor economic performance based on the criteria outlined in the previous section. Poor performance in allocative efficiency and income distribution arises from barriers to entry in computers. If there were no barriers to entry, excessive profits would be competed away by new firms or expanding old ones and thus could not remain for long. The estimated poorer than necessary performance on the progressiveness criteria is also due to barriers to entry. Without barriers to entry, new innovations from any source could be expected to reach the market more rapidly than at present. Concentration per se is not a problem of economic performance except insofar as it contributes to barriers to entry. It is indirectly the cause of at least part of the poor economic performance, because it is IBM's dominance of the industry which allows the creation of barriers to entry.

The second situation is poor performance on criteria that are not strictly economic. More dispute is likely among well intentioned observers in evaluating performance on these criteria because they relate to one's own value system and political beliefs. Chief among the non-economic criteria would be the distribu-

[18] *Ibid.* pp. 364–425 for a detailed discussion of innovations in the computer industry.

tion of power. Concentration is the key problem here and not barriers to entry. Even with relatively free entry, IBM would have substantial control over conditions in the computer industry with present levels of concentration. Because of the dependence of business and government operations upon computers, and the close ties of computer users to manufacturers, IBM maintains tremendous power over the functioning of modern economy.

These cases must be separated because emphasis on one or the other leads to different remedy proceedings. Because the author of this paper is an economist, the assumption taken here is that optimal economic performance in the industry is the primary goal of the proposed reorganization. This is not meant to imply that other goals are unimportant, but simply that other goals are less well defined and less generally accepted than the goal of good economic performance. The economic approach allows one to be objective about the costs in terms of economic performance of reaching other goals as well. To illustrate, suppose it could be shown that economies of scale existed in a given industry up to a scale of operations equal to 50% of the entire market.

On purely economic grounds, a proposal for reorganization of that industry could not have more than two firms, because otherwise inefficiency in production would result. However, if one believed that power in the economy must be dissipated, he would propose more than two firms in this hypothetical industry, explicitly balancing the loss to the economy from less efficient production against the gain from reduction in the concentration of economic power. Alternatively, if one believed that power must be controlled, he could propose a government regulatory agency to oversee the industry's operations, a path that has been followed with many industries which have too high economies of scale for effective competition. Because regulatory agencies incur some economic costs (at the very least, the salaries of the regulators and their counterparts in the industry who fill out forms, but often much more substantial losses because of disincentives to efficiency), the regulation approach is also a trade off between economic and non-economic goals.

Both brand loyalty and capital costs are increased through the vertical integration of the major manufacturers. The large capital cost comes from the necessity of setting up a vertically integrated organization to compete with the existing one. A potential entrant into the business systems market cannot manufacture just CPU's; he must introduce a complete line of CPU's and peripheral equipment, as well as software, maintenance, and other support services in order to compete for customers with the established companies. Consequently, capital costs are much higher than they would be if entry was possible into only one segment. Vertical integration increases brand loyalty because it contributes to the difficulty of evaluating equipment or switching among manufacturers. An integrated organization has no incentive to make the component parts of its computer compatible with other parts produced by different manufacturers. Consequently, a user must compare entire systems rather than specific devices, causing a decrease in the accuracy of the comparison. If the user decides that a competitive system is superior to his present one, he must replace the entire system rather than only the superior devices, causing increased costs.

The above analysis leads to the conclusion that the most improvement in economic performance would come about through a division of IBM into several companies by function, peripherals, CPU's, maintenance, etc. Although each company would dominate its market, barriers to entry would be low. Many variants of a functional reorganization plan are possible. The final plan chosen should be the one with the least disruption to customers or to IBM operations. If two operations are ordinarily handled together and there is no strong economic reason for separating them, they should be left together to minimize disruption.

Much of the information on IBM's current internal operations that would be necessary to formulate an exact efficient plan is not available to the author. The plan presented below should be treated as an example of the type of reorganization that would improve performance with minimal disruption. The principal of functional reorganization can be firmly established with current information from economic analysis, but the final details of which division should go to which new company cannot be determined without more complete information and analysis of the problem by persons in the relevant disciplines other than economics. The reorganization proposal has four objectives: (1) eliminate or drastically reduce barriers to entry, (2) minimize disruption or confusion on the part of computer users, (3) preserve the current operating efficiency of the IBM organization, and (4) avoid conduct restrictions that will require continuous

court supervision or put unreasonable restraints on the freedom of the new companies. No proposal can fully meet all four objectives because of the basic technology of the industry. For example, the existence of economies of scale in the software segment indicates that software ought to be left as a single company to meet objective 3, but leaving software together means that substantial barriers to entry remain at least in that segment. The author has used the criterion of economic performance when faced with a choice between objectives. Generally, this means that objectives 2 and 3 have been emphasized at the expense of objective 1 because the economic performance gains from a small decrease in barriers to entry are not great enough to outweigh the economic costs of substantial disruption. Because of the critical nature of computers in the economy, significant user disruption could have consequences well beyond the computer industry itself.

All of IBM's maintenance operations should be made into a single independent company, referred to here as Maintenance Company. All of IBM's current Field Engineering personnel, including managers and supervisors, would become part of the new company. IBM's current inventory of spare parts for maintenance purposes would be turned over to the new company. The Maintenance Company would be given non-exclusive rights to the current maintenance manuals and wiring diagrams for IBM equipment. Copies would also be made available to any interested party at reproduction cost. All maintenance contracts currently in force with IBM would go to the Maintenance Company. Maintenance for IBM machines currently on rent would be assigned to the Maintenance Company, initially at current IBM rates, unless the customer chose to make alternative arrangements. Where maintenance personnel now share office quarters with other IBM services, the Maintenance Company could continue in the same quarters by paying a commerically reasonable rent to the other company involved for a transitional period, but the company should be required to relocate its personnel within a reasonable time to assure independence from other IBM operations.

All of IBM's peripheral equipment operations should be separated into an independent company, here designated as Peripheral Company. All manufacturing facilities for producing discs, tapes, printers, card readers, terminals, or other types of input-output equipment would go to the Peripheral Company. The company would also receive facilities related to non-integrated controllers, but not for integrated controllers, memory, or CPU's. Research laboratories related to peripheral equipment would also go to the Peripheral Company. Where projects related to both peripherals and CPU's occur in the same laboratory, the laboratory should go to the predominant activity, with provision for transferring personnel among the laboratories as necessary. All IBM patents related to peripheral equipment would become the property of the Peripheral Company. The company would receive all peripheral equipment owned by IBM and not currently installed with a customer, but not the inventory of peripherals on rent. All orders placed for IBM peripheral equipment would automatically become orders for equipment from the Peripheral Company, unless the customer changed the order. The Peripheral Company would not be assigned IBM sales or maintenance personnel, but all other personnel associated with peripheral equipment, including production, research, and management personnel would be assigned to the new company. The company would receive nonexclusive rights to manuals and other documentation of the interface between peripheral products and CPU's for currently delivered products and future products for which IBM has already begun peripheral development work. Copies of the documentation received would also be made available to any interested party at reproduction cost. Future specifications could only be released to the Peripheral Company at the same time and under the same terms as they were released to all interested companies.

The third company, Marketing Company, would be IBM to most customers. It would receive the entire stock of IBM equipment installed on rent. Rental contracts would be split into a maintenance component, assigned to Maintenance Company, and an equipment rental component, assigned to Marketing Company. Marketing Company would receive IBM's library of application programs, including Type I, II, III, and IV programs, and all programs classified as Program Products except language compilers. It would not receive System Control Programming and language compilers. It would receive complete rights to all manuals and documentation relating to its programs. It would receive nonexclusive rights to the releases of System Control Programming and language compilers which are currently installed without separate rental charge, together with

their associated manuals and documentation. Other interested parties would also receive rights to those programs and manuals at reproduction costs. Marketing Company would not receive any rights to programs not assigned to it which are currently under separate charge.

Marketing Company would take over all of IBM's branch offices and the personnel associated with them except for maintenance personnel. All Systems Engineers, salesmen, data processing education personnel, and other people in the IBM organization concerned with sales and customer service would go to the Marketing Company. All IBM programmers assigned to programs of the type taken over by Marketing Company would go to that company. As with research personnel, care and flexibility would be necessary to separate systems programmers from applications programmers where both types currently work in the same facility. However, if properly done, it should cause minimal disruption and hardship. The Marketing Company would receive no hardware production or research facilities or patents. It would contract for maintenance services and hardware from other companies.

The fourth company, CPU Company, would receive the remaining IBM computer industry assets and personnel. This includes the plants and personnel associated with manufacturing components, memories, and CPU's, and the related laboratories and research personnel. CPU Company would receive all IBM patents associated with components, memories, and CPU's. The company would receive all IBM System Control Programming and language compilers, and the IBM personnel assigned to program upgrades and program maintenance, or new programs of that type. As with the Peripheral Company, the CPU Company would receive all CPU's, memories, or components currently owned by IBM but not installed with a customer. Outstanding orders for IBM CPU's and memories would automatically become orders to the CPU company.

The division of IBM's stock could be handled simply by giving each shareholder one share in each of the four companies for each share of IBM held. Past problems with this method in antitrust dissolutions have been due to a single dominant shareholder who retained control over the new companies. In IBM's case, the stock is widely dispersed with no dominant shareholders, so that no joint control over the four new companies could be exercised by stockholders owning shares in all. IBM's current management should be divided among the four new companies so as to minimize disruption. Once the management was divided, a new board of directors could be chosen for each company, subject only to the requirement that no person sit on the board of more than one of the new companies.

A few temporary conduct restrictions would be necessary to insure competition. Generally stated, the condition should be that the four companies could not give favored treatment of any kind to each other. Specifically, this means that the CPU Company could not release either interface specifications or maintenance information to the other IBM companies without making it available to any other company on the same terms. The CPU Company could not provide parts on a discriminatory basis. It could not refuse to deal or discriminate among customers in prices or terms of service unless the discrimination were price justified. The maintenance company could not sign an exclusive dealing arrangement with any of the other companies that prohibited it from maintaining non-IBM equipment. Similarly, the marketing company could not make any arrangements with the other IBM companies which restricted its freedom to market non-IBM computers or which restricted the freedom of Peripheral Company or CPU Company to sell to other marketing or leasing companies, or directly to customers. Because the four companies would each be dominant in their segment of the market at first, these conduct restrictions would generally hold anyway under current interpretations of the existing antitrust laws, but it could be advantageous to make the restrictions explicit to speed enforcement if the need should arise.

Some of IBM's operations (such as the Office Products Division which makes typewriters, dictating equipment, and copiers, and Science Research Associates which produces educational materials) are not a part of the computer industry. The non-computer operations could be either made a separate company or assigned to any one of the four companies without substantial effect on competition in the computer industry. IBM's foreign operations have not been explicitly considered in this analysis. Further study would be required to make a recommendation for IBM's foreign assets.

The Maintenance Company would dominate the maintenance industry in the beginning. However, it would have only minor economies of scale and some advan-

tage in reputation as barriers to entry. The basic barrier to maintenance entry, IBM control over information and parts distribution, would be eliminated. The Maintenance Company would write contracts with individual users, hardware manufacturers, or leasing or marketing companies. Although it would probably only maintain IBM equipment at first, self interest would cause the company to expand into the maintenance of non-IBM machines in the absence of collusion or restrictive agreements among the former IBM companies. We could expect Maintenance Company to remain dominant in sparsely populated areas but to face strong competition in major metropolitan centers, where population density practically eliminates economies of scale. Assuming Maintenance Company gave good service and retained low enough prices to avoid being driven out of business, it would probably retain some advantage over independents simply through size and visibility, but this would be a small enough advantage that it would not cause poor performance.

The separation of Maintenance Company is also designed to reduce barriers to entry in segments other than maintenance by providing a reliable maintenance service for the equipment manufactured by the new entrant. Some inedpendent maintenance companies currently exist (such as Comma Corporation), but an expansion of the independents as well as the willingness of the Maintenance Company to provide service to non-IBM machines is necessary in order to free prospective entrants from the necessity of setting up their own maintenance services. With maintenance separate, IBM could also lose control over machines it had sold rather than rented. Currently, IBM can control additions or modifications to IBM machines which the customer owns by the threat to cut off maintenance if the modification is harmful to IBM's competitive position.[19]

Very little disruption to either customers or IBM operations should be caused by separating the maintenance organization, so the reduction in barriers to entry should result in a clear gain in economic efficiency. More definite competition could be brought to the maintenance industry by separating Maintenance Company into several companies, but the economic gain from such a move would probably not be very significant. If such a move were desirable, the best method would be to divide Maintenance Company regionally, and then trust to expansion to provide competition among the resulting companies.

The current barriers to entry in the peripheral industry are due to IBM control of the interface specifications between CPU's and peripherals and IBM's ability to vary the profit margins on peripherals and CPU's to keep the same systems profit while reducing the profitability of peripheral production. Both of these would be eliminated by separating peripherals into a separate company. The CPU company would have to release interface specifications so that peripherals could be made and would be required to release them without favoring a particular company. The Peripheral Company would have to charge a profitable price because it would have no other products to sell. The Peripheral Company would retain a minor advantage over other companies through economies of scale and reputation.

Although the CPU company would probably continue to set interface standards in the beginning, the separation of peripherals would be a strong impetus to standardized interfaces between CPU's and peripherals. A standardized interface would be of great advantage to the user because it would allow him to select from a wide range of CPU's and peripherals and put together the combination that best fit his needs. With the current market structure, IBM has an incentive to strengthen the tie between peripherals and CPU's in order to protect the exposed peripheral market, making it unlikely that voluntary standardization efforts will succeed. With the new market structure, all companies involved would find it to their advantage to have a standardized interface, greatly increasing its chances for success. The peripheral companies would desire it because it would eliminate the need to redesign their products for every new CPU, and the CPU companies would welcome a standardized interface because it would eliminate concern over whether or not peripheral products would be produced which could be used with their CPU.

The Peripheral Company would have no sales or maintenance personnel at first. It could sell its products through the Marketing Company, or other leasing companies, and could develop a sales organization. A possible variation of the plan recommended here would be to give the Peripheral Company some share

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[19] See E. Drake Lundell, Jr., "Independent Memory Makers Weathered Maintenance Storm," Computer World VI (May 24, 1972), p. 40, for a report on IBM's threat to stop maintenance on IBM machines to which over-sized memories were attached.

of IBM's marketing personnel. However, it appears that there would be less possibility for user disruption by keeping the current marketing organization intact. The Peripheral Company would be strong enough in the market to survive any temporary disadvantage relative to other peripheral companies that occurred from its lack of an integrated sales and maintenance organization. No restrictions would be placed on Peripheral Company's freedom to develop its own sales and/or maintenance organization if it so desired.

The separation of Peripheral Company is designed to reduce barriers to entry both in the peripherals segment and in the CPU segment. Currently, there are a large number of independent peripheral makers who could provide peripheral equipment to a new CPU entrant, but IBM's recent policies have left the independents in a precarious financial and competitive position. With a large independent Peripheral Company, we can be confident that companies will be available which can supply a wide variety of peripherals to be used with any CPU that comes on the market.

Software is an inherently difficult problem in any proposal to make the industry more competitive because of its intrinsic economies of scale. The free market competitive system simply does not function efficiently when large economies of scale are present because it is impossible to have enough companies to provide competition without losing technical efficiency. The traditional solution in the U.S. economy has been to grant such industries monopolies and put them under regulation (electric power companies, pipelines, telephone companies, etc.). If we followed this tradition, we would suggest putting all software production under a single company and setting up a commission to regulate its price. The author has rejected this solution for the computer industry because of the observed stifling effect of government regulation on innovation and because of the great variations that are possible in the quality of software. Although free competition in software does lead to some wasteful duplication of effort, it seems more effective in meeting the needs of computer users than a single regulated software firm. The ability of thousands of small software firms to profitably compete with the few large ones suggests that effective economies of scale in software compete with the few large ones suggests that effective economies of scale in software are not so great as the theoretical analysis suggests. In particular, economies of scale are far more limited in application programs than in systems control programs because of the great variety of users needs.

The difference in economies of scale between application programs and systems control programs was the basis for the division of programming capability between Marketing Company and CPU Company. Competitive marketing companies can write application software to supply the same functions as that provided by Marketing Company if needed, or other types of application software which best meets the needs of their customers. However, all customers must have the use of the system control programs in order to use the machine. Consequently, if Marketing Company writes the control programs, it could effectively force all customers to buy the control programs from it or cause the alternative firms to take on the expensive and wasteful task of duplicating the system control programming.

The Marketing Company would have some protection from competition because of its reputation, software, and extensive consulting network. However, to break those up enough to eliminate barriers to entry would cause considerable user disruption. So long as the Marketing Company is kept intact, the user should see little harm from the reorganization. Users who felt they did not need extensive advice could make their own arrangements for various pieces of hardware and maintenance service. Those who felt less confident of their ability to evaluate all of the potential equipment could arrange with Marketing Company or similar competitive companies to find the best combination of equipment for them and provide whatever help was needed in the way of programming and design. No restrictions would be put on Marketing Company's freedom to price its services.

A strong case could be made for forming several marketing companies from the current IBM organization instead of only one. If Marketing Company were divided according to the current IBM regions, little user disruption would result because the local organizations would stay intact. At first little difference would exist between a single marketing company and regional marketing companies, but competition would increase as the regional companies expanded out of their home regions. The primary reason for regional division would be to be sure that Marketing Company did not make any official or understood restrictive agreements with the CPU Company. If Marketing Company purchases from CPU Company on an equal basis with other firms, and also makes a sincere effort

to provide the best equipment for its customers from all possible sources and not just the IBM companies, then competition and economic performance will be satisfactory with a single Marketing Company. If, on the other hand, Marketing Company only offers IBM equipment to its customers, and CPU Company only sells to Marketing Company, the performance will be unsatisfactory. Such a restrictive agreement would be far harder to reach with many marketing companies than with a single one. The disadvantage of further dividing Marketing Company is that the efficiency of some of the current application programmer groups could be disrupted by dividing them. There would also be some loss in ability to shift highly specialized personnel to various areas of the country when needed to solve unusual problems. The author does not have the information available to distinguish between the relative benefits of a single Marketing Company with a prohibition of restrictive practices and of a set of regional marketing companies with no restrictions on their conduct. In either case, the marketing division would retain some market power but not enough to dominate the industry.

As with the separation of peripherals and leasing, the separation of marketing is designed to reduce barriers to entry in other segments than marketing. Because Marketing Company would provide leasing services and customer contacts, it would ease the problems of a company trying to enter any segment of the computer business. One of the Marketing Company's functions would be that of a professional evaluator of available equipment. It would be easier for a new company with superior equipment to convince a professional evaluator of that fact than to convince every customer. A firm with special capabilities in a narrow segment of the computer industry could sell its products through Marketing Company or its competitors without the necessity of setting up a complete customer service organization and integrated product line.

CPU Company would have the most extensive economies of scale because of its production of systems software. Because there are few if any economies of scale in the actual production of hardware, it would be desirable to separate CPU production from control program production in order to allow competitive CPU makers the option of purchasing a control program. However, such a separation appears to be technologically infeasible. The design of the CPU and the control program are closely intertwined. Many functions can be provided by either hardware or software. A CPU Company which could not produce its own control programs would be forced to design new CPU's so that they would be usable with the existing control programs in order to be sure that a control program would be available when needed. Similarly, the control program writers would be forced to write programs according to the specifications of existing computers. Inefficiency and a slowing of technical progress could be expected from separating CPU and control program operations.

If the companies are not separated, there does not appear to be a way to guarantee alternate CPU makers access to the CPU Company control programs without extensive regulation. A simple requirement that the CPU and Control Program be priced and sold separately without making one conditional upon the other would not be sufficient. The CPU Company could put most of the price on the control program (which is fairly protected from competition due to economies of scale) and a lower price on the actual CPU which would have no protection from competition. This problem could be solved by requiring the company to make the same profit rate on programming and CPU manufacturing, but that would restrict the company's ability to respond to market forces and require regular supervision. It seems better to put no restrictions on the pricing policies of CPU Company (other than the exclusion of restrictive agreements with the other IBM companies mentioned above) and accept the necessity for a competitive CPU maker to produce its own operating system. This restricts the freedom of very small firms to enter but is not an insurmountable obstacle to medium size firms as evidenced by the success of IBM's competitors in producing effective and innovative system control programs.

Although barriers to entry in the CPU segment of the business would still exist, they would be greatly reduced because of the existence of other companies to provide maintenance, leasing, marketing, and peripherals. The necessity to build an integrated organization with its consequent huge capital costs and long period of losses would be gone, and the new entrant would be faced with the basic problem of providing a needed product more cheaply than the existing companies. The scope for exploitation of technical breakthroughs by a small company would be greatly expanded because it would not have to provide all the services needed by the customer itself. The existence of alternate CPU

companies would also reduce barriers to entry in the other markets because it would provide alternate sources of CPU's if CPU Company did not provide the needed products or charged a price far above the competitive level.

Some reduction in barriers to entry in CPU production could be gained by prohibiting CPU Company from renting. However, that restriction would increase the power of the Marketing Company by restricting customers who wanted to rent from dealing directly with the CPU Company. On balance, it appears that no net gain in economic performance would result from such a restriction.

The above proposal should restore competition to the industry with very little user disruption or loss in efficiency, and with little need for continuing restrictions. However, continuing court supervision would be needed to interpret and enforce the ban on restrictive agreements among the new companies. For example, the CPU Company might announce that it was selling the system control programs for a flat fee which then entitled the buyer to reproduce or remarket them for use on any number of CPU's. If the flat fee were set very high, only Marketing Company would find it economical to pay the fee because of its large base of customers to whom the control program could be resold. In this case, a tie would be created between CPU Company and Marketing Company because neither individual customers or other marketing companies could buy rights to the control programs directly from CPU Company. Although a restriction on this particular pricing behavior could be written into a dissolution agreement, it is unlikely that all possible such arrangements could be perceived at the time of dissolution. Consequently, it would be better to put in a general ban on restrictive agreements or pricing policies and allow the court to interpret it in specific situations as they arose.

There is still a possibility of non-competitive conduct in the computer industry even with the dissolution agreement in effect. The above plan was chosen as the best compromise between free competition and avoiding disruption to the industry. It is possible that further study of IBM's operations (including studies by persons with technical skills not possessed by the author) would indicate that the proposed four companies could be further subdivided in such a way as to improve performance over the four company plan presented here.

No change would be made to companies other than IBM. The non-IBM companies control too small a share of the market to block competition through integration. With the increase in standardization that could be expected to result from the reorganization of IBM, customers would gain a wider choice of equipment both from the former IBM companies and new entrants to the industry, and from the existing integrated competitors to IBM, because the various pieces of equipment would be more easily interchangeable. Customers could make more precise choices than at present because they could evaluate each piece of equipment individually rather than the entire system at once. Customer choice should be increased, prices should be reduced because of freer entry, and the rate of technological progress should be increased because of the increased ability of a new company to market an innovation. A clear gain in economic performance can be expected from the proposed reorganization of IBM.

APPENDIX

United States District Court for the Southern District of New York

(Civil Action No. 69–Civ 200 Filed: January 12, 1969)

United States of America,
plaintiff,

versus

International Business Machines Corporation,
defendant.

COMPLAINT

The United States of America, by its attorneys, acting under the direction of the Attorney General of the United States, brings this action against the defendant named herein and complains and alleges as follows:

JURISDICTION AND VENUE

1. This complaint is filed and this action is instituted against the defendant under Section 4 of the Act of Congress of July 2, 1890, as amended (15 U.S.C. §4) commonly known as the Sherman Act, in order to prevent and restrain the continuing violation by the defendant, as hereinafter alleged, of Section 2 of the Sherman Act (15 U.S.C. §2).

2. Defendant International Business Machines Corporation has offices, transacts business and is found within the Southern District of New York.

DEFENDANT

3. International Business Machines Corporation, hereinafter referred to as "IBM," is made a defendant herein. IBM was organized under the laws of the State of New York in 1911 and asusmed its present name in 1924.

4. IBM is the largest manufacturer of information handling systems in the world. It develops, manufactures and markets electronic and punched card data processing machines and systems, as well as electric typewriters, dictation equipment, and related supply items. In 1967 IBM had total revenues of $5,345,-291,000 with total assets of $5,598,670,000 and net income of $651,500,000.

5. IBM conducts its worldwide business through 11 divisions and three subsidiaries. The Service Bureau Corporation, a wholly-owned, but independently operated subsidiary, furnishes data processing services on a fee or contract basis to its customers in the United States. Science Research Associates, Inc., acquired by IBM in 1964 and now operated as a wholly-owned subsidiary, develops and markets instructional and guidance materials and a wide variety of intelligence, aptitude and achievement tests. IBM World Trade Corporation, another wholly-owned subsidiary, conducts all of IBM's business, except that of Science Research Associates, Inc., in over 100 countries outside the United States.

TRADE AND COMMERCE

6. As used herein, a computer is an electronic device which processes information as desired by activating electronic impulses in pre-defined sequences. Digital computers, which represent over 95% of all computer sales and leases, are machines which process information which is symbolized by numerals and processed in that form.

7. A computer system, sometimes referred to as an electronic data processing system, consists of a machine or a group of automatically intercommunicating machine units capable of entering, receiving, storing, classifying, computing and/or recording data, which system includes at least one central processing

unit and one or more storage facilities, together with various input and output equipment.

8. Computer hardware includes all the physical components used in a computer system. Computer software includes the programming know-how and materials necessary to make the computer hardware operative. Computer support includes all manpower and other assistance necessary to make and keep the computer hardware and software operative.

9. The general purpose digital computer is one which has general commercial application and is offered for sale or lease in standard model configurations. Special purpose digital computers are designed for particularized needs or purposes and are produced for use by a limited number of customers but not made generally available to all customers.

10. The computer industry is an extension or outgrowth of the electrical tabulating industry. Electrical tabulating machines are devices for recording on a unit basis, and automatically classifying, computing and printing alphabetic and numeric accounting and statistical information by controlled electrical means. IBM was originally organized as the Computer-Tabulating-Recording Co. and from 1911 to 1933 it owned a majority of the capital stock of, and controlled, The Tabulating Machine Company, a corporation organized in 1905 under the laws of the State of New Jersey. During this period IBM operated in the tabulating field through The Tabulating Machine Company, which was merged with IBM in 1933. The tabulating business continued to represent the major product line of IBM until the advent of the electronic computer in the 1950's.

11. In 1932 the United States filed a civil antitrust suit against IBM and Remington Rand, Inc. charging that they had unreasonably restrained and monopolized interstate trade and commerce in tabulating machines and tabulating cards by entering into agreements in which they agreed:

(a) to lease only and not sell tabulating machines;

(b) to adhere to minimum prices for the rental of tabulating machines at fixed by IBM, and

(c) to require customers to purchase their card requirements from the lessor or pay a higher price for the rental of machines.

The agreements between IBM and Remington Rand, Inc. were cancelled in 1934 prior to the trial of that suit, and the issues presented by the agreements were withdrawn from the case. The lease provision requiring the lessees to purchase cards from the lessor was adjudged to be illegal by this Court. (13 F. Supp. 11, affirmed 298 U.S. 131).

12. On January 21, 1952 the United States filed another civil antitrust suit against IBM charging that it had violated Sections 1 and 2 of the Sherman Act by attempting to monopolize and monopolizing interstate trade and commerce in the tabulating industry. The complaint alleged that IBM owned more than 90% of all the tabulating machines in the United States and manufactured and sold about 90% of all tabulating cards sold in the United States. This suit was terminated by the entry of a consent judgment by this Court on January 25, 1956 (Civil Action 72–344).

13. Although a few experimental computers were assembled during the late 1940's, the general purpose digital computer did not have its beginning until the early 1950's. The first installations of general purpose digital computers were made by Remington Rand, Inc. beginning in 1951. IBM followed with its first general purpose digital computer being produced and delivered near the end of 1952.

14. Remington Rand, Inc., which was later merged with Sperry Corporation to form Sperry Rand Corporation, took the early lead in the development and sale of general purpose digital computers. However, IBM surpassed that company in the sales of such computers by the late 1950's. Both companies' early activities in the general purpose digital computer marketplace were regarded primarily as extensions of their earlier activities in the tabulating industry. The prior customers for the tabulating machinery presented an inherent source of potential users of general purpose digital computers.

15. The computer industry has been one of tremendous growth. By 1955 some 400 computers had been installed in the United States. By 1960 the number of installations approximated 6,000 and by the end of 1967 the number of computer installations exceeded 43,000. In terms of total revenues from the sale of general purpose digital computers, the industry has seen an increase from approximately $600,000,000 in 1961 to in excess of $3,000,000,000 in 1967.

16. IBM's total revenues from the sale or lease of general purpose digital computers in the United States increased from $506,668,000 in 1961 to $2,311,353,000 in 1967. During this period of time IBM's share of total industry revenues of these products varied from approximately 69% to approximately 80%. In 1967 IBM's share of such revenues was approximately 74%. Its nearest competitor in 1967 had revenues of approximately $156,000,000 or 5% of the total.

17. Approximately 76% of the value of all general purpose digital computers shipped in the United States in 1967 were shipped by IBM while its two nearest competitors together accounted for about 8% of such shipments. At the end of the same year, approximately 67% of the value of all installed general purpose digital computers in the United States was represented by machines that had been manufactured by IBM.

18. IBM manufactures general purpose digital computers at its plants located in Poughkeepsie and Endicott, New York, and manufactures parts, components and subassemblies at numerous other plants in the United States. Such computers and related products are shipped to customers located throughout the United States.

OFFENSES

19. Beginning in or about 1961 and continuing up to and including the date of the filing of this complaint, the defendant has attempted to monopolize and has monopolized the aforesaid interstate trade and commerce in general purpose digital computers in violation of Section 2 of the Sherman Act (15 U.S.C. § 2). Said offenses are continuing and will continue unless the relief hereinafter prayed for is granted.

20. Pursuant to and in furtherance of the aforesaid attempt to monopolize and the monopolization, the defendant has pursued a manufacturing and marketing policy that has prevented competing manufacturers of general purpose digital computers from having an adequate opportunity effectively to compete for business in the general purpose digital computer market, and has done, among other acts, the following:

(a) Maintained a pricing policy whereby it quotes a single price for hardware, software and related support and, thereunder, (i) discriminated among customers by providing certain customers with extensive software and related support in a manner that unreasonably inhibited the entry or growth of competitors; and (ii) limited the development and scope of activities of an independent software and computer support industry as a result of which the ability of its competitors to compete effectively was unreasonably impaired;

(b) Used its accumulated software and related support to preclude its competitors from effectively competing for various customer accounts;

(c) Restrained and attempted to restrain competitors from entering or remaining in the general purpose digital computer market by introducing selected computers, with unusually low profit expectations, in those segments of the market where competitors had or appeared likely to have unusual competitive success, and by announcing future production of new models for such markets when it knew that it was unlikely to be able to complete production within the announced time; and

(d) Dominated the educational market for general purpose digital computers, which was of unusual importance to the growth of competitors both by reason of this market's substantiality and by reason of its ultimate impact on the purchasing decisions in the commerical market, by granting exceptional discriminatory allowances in favor of universities and other educational institutions.

EFFECTS

21. The aforesaid offenses have had, among other things, the following effects:

(a) The defendant has monopolized and continues to monopolize the general purpose digital computer market in the United States;

(b) Actual and potential competition in the manufacture and marketing of general purpose digital computers in the United States has been restrained; and

(c) Competitors of IBM have been improperly deprived of the opportunity to earn competitive profits on their general purpose digital computers and actual and potential competitors have been discouraged from entering or continuing in the business of manufacturing and marketing general purpose digital computers.

PRAYER

Wherefore, the plaintiff prays:

1. That the Court adjudge and decree that the defendant has attempted to, and did monopolize interstate trade and commerce in the general purpose digital computer industry in violation of Section 2 of the Sherman Act.

2. That the defendant and all persons, firms, and corporations acting in its behalf or under its direction or control be permanently enjoined from engaging in, carrying out, or renewing any contracts, agreements, practices, or uderstandings, or claiming any rights thereunder, having the puropse or effect of continuing, reviving, or renewing the aforesaid violation of the Sherman Act, or any contract, agreement, combination or conspiracy having like or similar purpose or effect.

3. That the defendant hereafter be required to price separately and to offer to sell or lease separately, and to sell or lease separately to any applicant upon such terms and conditions as the Court may direct (a) general purpose digital computers; (b) peripheral equipment; (c) computer software; and (d) other customer support which it manufacturers or offers to its customers.

4. That the defendant hereinafter be required to refrain from the use of special allowances, buy-backs of computer time, or research grants, in the sale or lease of any and all general purpose digital computers, peripheral equipment, computer software and other customer support equipment or services which it manufacturers or offers to any of its customers, where the effect of such practices may be unreasonably to inhibit the entry or growth of competitors.

5. That the defendant hereinafter be required to refrain from entering into the production of computer hardware which is not likely to result in returns reasonably related to returns from other computer hardware products sold or leased, or which could be sold or leased, by the defendant.

6. That the defendant hereinafter be required to refrain from the announcement of the development or production of any planned computer hardware or software until such product has been subjected to normal testing.

7. That the plaintiff have such relief by way of divorcement, divestiture and reorganization with respect to the business and properties of the defendant as the Court may consider necessary or appropriate to dissipate the effects of the defendant's unlawful activities as hereinbefore alleged in this complaint, and to restore competitive conditions to the general purpose digital computer industry.

8. That the plaintiff have such other and further relief as the nature of the case may require and the Court may deem proper in the premises.

9. That the plaintiff recover the costs of this suit.

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UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF NEW YORK

(Civil Action 69 Civ. 200.)

UNITED STATES OF AMERICA, PLAINTIFF,

versus

INTERNATIONAL BUSINESS MACHINES CORPORATIONS, DEFENDANT.

PLAINTIFF'S PRELIMINARY STATEMENT OF TENTATIVE TRIABLE ISSUES [1]

MARKET MEASUREMENT

1. Whether in any relevant market or markets herein defendant's pre-Complaint [2] records of market measurement provide an appropriate measurement of the universe or denominator of such market or markets and defendant's share therein, in determining whether defendant has (a) attempted to monopolize or (b) monopolized such market or markets.

2. Whether in any relevant market or markets herein defendant's post-Complaint records of market measurement provide an appropriate measurement of the universe or denominator of such market or markets and defendant's share therein, in determining whether defendant has (a) attempted to monopolize or (b) monopolized such market or markets.

3. Whether IBM effected changes in its market measurement policies and practices on or about the time of the filing of the Complaint and if so whether such changes show or tend to show IBM's knowledge that its prior market measurement policies and practices revealed that it possessed a monopoly share in any relevant markets or submarkets.

4. Whether plaintiff's evidence of intent to monopolize establishes or tends to establish the market universe and/or defendant's share in any relevant market or markets.

5. Whether in any relevant market or markets herein, statistics routinely collected and disseminated by persons expert in such industry measurement provide an appropriate measure of the universe or denominator of such market or markets and defendant's share therein, in determining whether defendant has (a) atempted to monopolize or (b) monopolized such market or markets.

6. Whether, in determining the market universe and defendant's share thereof, any one or more of the following is a relevant measure of the markets herein involved:

(a) Dollar value of shipments of new systems or products;

(b) Unit value of shipments of new systems or products;

(c) Dollar value of the installed inventory of systems or products manufactured by each company;

(d) Unit volumes of the installed inventory of systems or products manufactured by each company;

(e) "Net position" (A term used by IBM to measure products on order plus installed products minus products that are going to be removed.) of products manufactured by each company;

(f) Revenue obtained from the sale or lease of systems or products.

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[1] This filing is intended to supersede "Plaintiff's Tentative Statement of Tentative Triable Issues" dated October 13, 1972.

[2] As used herein, "pre-Complaint" refers to that period of time prior to January 17, 1969; and "post-Complaint" refers to that period of time after January 17, 1969, and including that date.

7. Whether in the measurement of the relevant market or markets, the lease-price equivalent and/or the purchase-price equivalent are appropriate indices of value of new systems or products shipped or of the installed inventory of systems or products manufactured.

MARKET STRUCTURE AND INDICIA OF MONOPOLY POWER

1. Whether IBM's share of the relevant markets characterizes those markets as monopolized markets.
2. Whether the sustained high level of profitability by IBM during a period substantial growth of the relevant markets, accompanied by an absence of significant entry and the exit of two of the leading industrial enterprises in the United States, GE and RCA, characterizes the relevant markets as monopolized markets.
3. Whether there exist or have existed substantial barriers to entry by new competitors that contribute or have contributed to the sustained monopolization by IBM of the relevant markets.
4. Whether there exist or have existed substantial barriers to expansion by existing competitors that contribute or have contributed to the sustained monopolization by IBM of the relevant markets.
5. Whether the enormous market power of IBM constitutes a barrier in the sense used in 3 or 4.
6. Whether the monopoly power of IBM in a given market results in part from its market power in closely related markets.
7. Whether IBM's ability to price its products substantially higher than the comparable products of its competitors in the relevant markets shows or tends to show its control over price, its power to exclude competitors and, thereby, its monoply power.
8. Whether IBM has the ability to establish product standards unilaterally, and if so, whether this ability shows or tends to show that IBM possesses monopoly power.
9. Whether the size of IBM, both aboslute and relative to its competitors, in terms of revenues, profits, research and development expenditures, total assets, accumulated liquid assets, number of employees, etc., serves to maintain its monopoly position in the relevant markets.
10. Whether potential competition from whatever source constitutes an effective deterrent to IBM's exercise of its monopoly power in the relevant markets.

INTENT TO MONOPOLIZE

1. Whether IBM intended to monopolize the relevant markets herein.
2. Whether such intent is evidenced in part by IBM's marketing practices relating to pricing, leasing, product announcements and product developments, customer or supplier relations and educational allowances.
3. Whether statements by IBM officials and employees, including those disclosed in IBM documents, evidence IBM's intent to maintain its monopoly position in the relevant markets.

BUNDLING

1. Whether IBM, in furtherance of its attempt to monopolize and the monopolization of the relevant markets herein, engaged in "bundling," i.e. marketing a combination of computer products and services for a single price, for the purpose or with the effect of discouraging or forestalling the growth or entry of competitors in the relevant markets.
2. Whether IBM believed or had reason to believe that its single or bundled pricing enabled it to exert greater control over the relevant markets than would be possible under an unbundled pricing system.
3. Whether IBM's single or bundled pricing enabled it to exert greater control over the relevant markets than would be possible under an unbundled pricing system.
4. Whether IBM believed or had reason to believe that its employment of single or bundled pricing permitted it to price discriminate among its customers or potential customers by varying the amount of customer support services it offered or supplied.
5. Whether IBM's employment of single or bundled pricing permitted it to price discriminate among its customers or potential customers by varying the amount of customer support services it offered or supplied.

6. Whether IBM utilized its single or bundled pricing to price discriminate among its customers by varying the amount of customer support services offered or supplied, depending upon the competition encountered, the prestigiousness of the account, and/or the desirability of obtaining or maintaining a particular account.

7. Whether IBM believed or had reason to believe that its employment of a single or bundled price inhibited the growth of independent competitors in the computer support field.

8. Whether IBM's employment of a single or bundled price did inhibit the growth of independent competitors in the computer support field. If so, whether such an inhibition prevented, discouraged or forestalled the entry or expansion of other companies engaged in the manufacture and marketing of products in the relevant markets.

9. Whether IBM, in furtherance of its attempt to monopolize and the monopolization of the relevant markets herein, engaged in some or all of the techniques set forth below, for the purpose or with the effect of discouraging or forestalling the growth or entry of actual competition in the peripheral equipment market and the potential competition in the relevant markets herein which manufacturers and marketers of said peripheral equipment represented:

(a) IBM's post-Complaint announcements of changes in its product lines, marketing policies and prices with respect to its peripheral equipment;

(b) IBM's June 1971, Fixed Term Plan announcement;

(c) IBM's August 1971, Extended Term Plan announcement;

(d) IBM's technological rebundling in its recent announcements with respect to the memory units, file adapters and selector channels of its 370 Series general purpose digital computer systems.

FIGHTING MACHINES

1. Whether IBM, pursuant to and in furtherance of its attempt to monopolize and the monopolization of the relevant market or markets herein, restrained or attempted to restrain competitors from entering, remaining or expanding in one or more of the relevant markets by announcing and introducing selected computer products, with unusually low profit expectations, in those markets or segments of the markets where the competitive success of such competitors affected or appeared likely to affect IBM's monopoly position in one or more of the relevant markets.

2. Whether IBM, pursuant to and in furtherance of its attempt to monopolize and the monopolization of the relevant markets herein, restrained or attempted to restrain competitors from entering, remaining or expanding in one or more of the relevant markets by announcing future production and marketing of computer products for such markets when it believed or had reason to believe that it was unlikely to be able to produce and market such products within the announced time frame.

3. Whether IBM, pursuant to and in furtherance of its attempt to monopolize and the monopolization of the relevant markets herein, restrained or attempted to restrain competitors from entering, remaining or expanding in one or more of the relevant markets by developing and announcing computer products primarily for the purpose of discouraging actual and potential customers from acquiring, by purchase or lease, computer products being marketed by its competitors.

4. Whether IBM, pursuant to and in furtherance of its attempt to monopolize and the monopolization of the relevant markets herein, restrained or attemped to restrain competitors from entering, remaining or expanding in one or more of the relevant markets by advancing announcement dates for various computer products, particularly the announcement of its system/360 on April 7, 1964, when, in fact, such products were not tested or announced in conformance with IBM's established procedures on product announcement and marketing.

5. Whether IBM, pursuant to and in furtherance of its attempt to monopolize and the monopolization of the relevant markets herein, misrepresented to customers or potential customers the characteristics, delivery dates capabilities and/or specifications of new or modified (or purportedly new or modified) computer products for the purpose of or with the effect of hindering competition.

LEASING

1. Whether IBM, in furtherance of its attempt to monopolize and the monopolization of the relevant markets herein, engaged in one or more of the fol-

lowing practices for the purpose or with the effect of encouraging customers and potential customers to lease from IBM the products in the relevant market:

(a) Manipulation of the relationship between the lease and purchase prices so as to encourage the lease of its equipment and discourage the purchase of its equipment;

(b) Employment of a "subsequent user" policy which discriminated against subsequent users with respect to the denial of customer support, engineering and maintenance services provided by IBM to first users;

(c) Denial or threatened denial of maintenance services to customers or potential customers of independent leasing companies when such customers or potential customers used or intended to use non-IBM memory units with an IBM central processing unit;

(d) Announcement and offering of extended and long-term product leases at substantial discounts with substantial penalties for premature termination;

(e) Employment of salesmen compensation policies designed to encourage salesmen to attempt to lease rather than to sell computer equipment;

(f) Refusal to lease add-on equipment to customers who have purchased their products.

2. Whether IBM, in furtherance of its attempt to monopolize and the monopolization in the relevant markets herein, engaged in one or more of the practices set forth in 1 hereof for the purpose or with the effect of creating a lease-oriented environment so as to raise the barriers to entry or expansion in such markets by any competitor or potential competitor by creating extreme capital requirements.

EDUCATIONAL ALLOWANCES

1. Whether IBM, pursuant to and in furtherance of its attempt to monopolize and the monopolization of the relevant market or markets herein, restrained or attempted to restrain competitors from entering, remaining or expanding in the relevant markets by granting exceptional discriminatory allowances and other considerations to educational and scientific institutions, as well as other prestige accounts, for the purpose of

(a) Maintaining IBM computer installations at prestige accounts, and

(b) Insuring familiarity among graduates of educational institutions with IBM products.

2. Whether the practices by IBM listed in 1 hereof had the purpose or effect of excluding competitors or potential competitors from such accounts, thereby inhibiting the entry or growth of such competitors both by reason of the substantiality of these accounts and by reason of the ultimate impact on the purchasing decisions by customers in one or more of the relevant markets.

Respectfully submitted,

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Dated: December 12, 1973.

UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF NEW YORK

(Civil Action 69 Civ. 200.)

UNITED STATES OF AMERICA, PLAINTIFF

versus

INTERNATIONAL BUSINESS MACHINES CORPORATION, DEFENDANT

PLAINTIFF'S PRELIMINARY MEMORANDUM ON RELIEF

On September 12, 1972, the Court directed plaintiff to submit, on October 16, 1972, a tentative application for relief as seen by plaintiff at this stage in its pretrial preparation (Pretrial Order No. 6). Because of the protracted nature of this case and the substantial discovery and evidentiary hearings yet to be had,

plaintiff is unable at this time to specify with any more significant degree of precision than contained herein the exact relief which it may ultimately consider appropriate to create competition and to remedy the alleged violation of the antitrust laws in the markets involved in this case.

While plaintiff is unable to state that the principles of relief herein set forth will ultimately prove to be the best of many alternatives, the tentative outline suggested herein reflects plaintiff's best economic judgment as of this date, based upon an incomplete and sometimes equivocal factual record. Inasmuch as this is the present state of the record, this statement is in part premised upon the proposition that divestiture such as that proposed is the normal, natural and appropriate form of relief in monopolization cases under section 2 of the Sherman Act.

Preparation of this statement on relief has demonstrated to plaintiff that, before any type of relief can be finalized in this matter, a more thorough and detailed analysis must be made of the markets which defendant is alleged to have monopolized. Such analysis will require the development of additional facts through further discovery and evidentiary proceedings involving personnel engaged in these various markets. This further analysis may demonstrate that other forms of divestiture, or divestiture coupled with injunctive relief, may be sufficient to remedy the effects of the alleged monopolization. However, plaintiff notes that injunctive relief has in the past met with only limited success. On occasion, such provisions have been overly regulatory, inhibiting rather than preserving or restoring competition in the long run. Decretal provisions barring entry into specified businesses have adversely affected competition in the prohibited markets. See, *e.g.*, *United States* v. *Swift & Co.*, 276 U.S. 311, 328–29 (1928), *decree modified*, 1971 CCH Trade Cases ¶ 73.760 (N.D.Ill.). Similar provisions can have an adverse effect on competition, incentive and innovation in markets related to the primary business of an enterprise. Finally, highly regulatory decretal provisions can involve inordinate amounts of administrative and judicial time directed toward securing performance of the decree. See, *e.g.*, *United States* v. *Paramount Pictures, Inc.*, Equity No. 87–273, S.D.N.Y. (filed July 20, 1938).

Accordingly, plaintiff believes that the parties should direct their efforts to achieving a fully developed record upon which to evaluate the future efficacy of this or other forms of relief. Analysis of this record may modify, rule out or reinforce the principles set forth herein.

I.

Upon the present record, should plaintiff prevail at trial, plaintiff tentatively seeks:

A. Divestiture relief designed to dissipate the enormous market power of the current IBM computer manufacturing and marketing structure by the formation of the total domestic and international computer systems facilities of IBM (manufacturing, marketing, research and development, capital, patents and know-how) into several discrete, separate, independent and competitively balanced entities capable of competing successfully in domestic and international markets with one another and with other domestic and foreign competitors.

B. The entities resulting from the divestiture should, after an appropriate transitional period, be relatively unfettered in their ability to engage in domestic and international competition with one another in the manufacture, marketing (including leasing) and maintenance of a broad line of computer systems or any part thereof, or lawfully to engage in any related or unrelated field of endeavor.

C. The relief outlined immediately above should be accompanied by protective provisions designed to insure that the entities resulting from the divestiture continue to provide service effectively to existing users of IBM equipment. This is to be achieved by injunctive provisions designed to insure all these entities the necessary access to know-how, equipment and parts so that they can provide customers with a broad line of computer equipment, parts, software, maintenance and other services during an appropriate transitional period following divestiture.

II.

Relief should include injunctive provisions designed to prohibit IBM, pending effectuation of divestiture, from acting so as to frustrate the orders of this Court, or to put significant aspects of its business beyond the reach of the Court, including, but not limited to, the following:

A. Change in ownership or control of subsidiaries or divisions, other than in the ordinary course of business;

B. Change in financial or employment procedures, other than in the ordinary course of business;

C. Realignment of plants, personnel or capital, other than in the ordinary course of business.

III.

Relief should also include injunctive provisions designed to prohibit IBM, pending effectuation of divestiture, from:

A. Marketing its computer systems or any part thereof, its software, and its support services by the use of bundled prices;

B. Pricing any computer system or any part thereof, its software, or its support services at loss or other predatory levels, or discriminating in price, for the purpose or with the effect of hindering competition;

C. Announcing new computer products or systems prior to the time that such products or systems have reached the point of manufacturing and marketing feasibility, for the purpose of hindering competition.

Respectfully submitted.

RAYMOND M. CARSON,
JOSEPH H. WIDMAR,
Attorneys, U.S. Department of Justice.

Dated: October 13, 1972.

IN THE UNITED STATES COURT OF APPEALS FOR THE NINTH CIRCUIT

No. 72–2553

GREYHOUND COMPUTER CORPORATION, INC., PLAINTIFF-APPELLANT

vs.

INTERNATIONAL BUSINESS MACHINES CORPORATION, DEFENDANT-APPELLEE

APPEAL FROM THE UNITED STATES DISTRICT COURT FOR THE DISTRICT OF ARIZONA

HONORABLE WALTER E. CRAIG, DISTRICT JUDGE

APPENDIX OF PLAINTIFF-APPELLANT

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RULING OF JUDGE CRAIG DIRECTING VERDICT IN FAVOR OF DEFENDANT

July 10, 1972

The Court: I might say, gentlemen, that the burden placed on the Court by your respective motions is indeed an unhappy one.

With respect to the plaintiff's motion for directed verdict on the issue of liability, the motion is denied.

With respect to the plaintiff's motion for directed verdict on the issue of monopolization, the motion is denied.

With respect to the defendant's motion for directed verdict on the contract issue, the motion is granted.

The Court is of the opinion that, number one, the proof is not sufficient to submit that question to the jury, even with appropriate instructions as to the law.

The Court is of the opinion that that issue is resolved by the parol evidence rule, the statute of frauds, and last, but not least, the local rules of this court.

Even considering the Uniform Commercial Code of New York, my understanding is that the parties agree that is the law applicable to this case. As I say, having considered that, the Court is of the opinion that that issue is foreclosed under the parol evidence rule.

Moreover, the only two contracts in evidence have integration clauses which limit the subject matter of the contract.

The final motion of the defendant as to a directed verdict with respect to Section 2 of the Sherman Act posed more difficult problems to the Court.

The Court is of the opinion that the evidence with respect to the market and the defendant's relative share of the market is insufficient to submit that issue to the jury. Assuming for the purposes of argument that that issue might be submitted to the jury on the present status of the record, the Court is of the opinion that the evidence is insufficient to submit the question as to defendant's control or ability to control the market regardless of its purported relevant share thereof.

The Court is of the further opinion that with respect to the issue of monopoly by the defendant, that the record is insufficient to submit that issue. Assuming that the defendant does hold a substantial share of a market, whatever that market may be, it is the opinion of this Court from the evidence adduced thus far on the record that the defendant's place in the industry has been achieved as a result of superior skill, foresight and industry.

The Court is of the opinion, from the evidence adduced at trial, that such activity as was engaged in by the defendant with respect to its pricing, both in leases and purchases, was brought about by economic factors over which defendant had no control.

The same reasoning applies to the issue with respect to attempt to monopolize. This Court is of the opinion that there is no evidence of an attempt to monopolize in the record.

And finally, the Court is of the opinion that with respect to the issue on damages, were the jury to consider this record in its present state it would be purely speculative as to how the jury would reach a conclusion in that respect.

From this Court's days in law school, which is a very long time ago, apparently it is still the law that size alone does not constitute an offense under the Sherman Act, nor does the mere possession of monopoly power.

It is the wrongful use and exercise of that power which is proscribed by Section 2 of the Act.

This Court is of the opinion that the opinions in Alcoa, United Shoe, American Tobacco and Grinnell do not apply to the circumstances in this case, and rather du Pont is closer to an analogy.

The Court is also cognizant of the language in Bushie by the Ninth Circuit.

I might say, gentlemen, that it would have been much easier to avoid this issue, but I don't believe that that is the function of the Court, and therefore with respect to defendant's motion for directed verdict with respect to Section 2 of the Sherman Act, the motion is granted.

In the United States District Court for the Northern District of Oklahoma

No. 72–C–18; No. 72–C–89 (Consolidated)

The Telex Corporation and Telex Computer Products, Inc., plaintiffs,

v.

International Business Machines, Corporation, defendant.

Findings of Fact and Conclusions of Law

Contents

40-927—75——53

GENERAL

Finding 1. This case involves the electronic data processing industry—an industry based upon a concept and system or reckoning (binary) as simple as turning on and off a switch; in which transmissions are timed in billionths of seconds (nanoseconds), storage capacity (memory), measured by millions of combinations of bits of information (megabytes); in which numerous problems involving logic or arithmetic functions are separately but simultaneously worked upon and instantly solved within a single system; in which in their own peculiar language machines communicate with one another (multiprocessing) and then in words understandable by humans may present printouts of results at the rate of as much as 2,000 lines per minute; in which devices facilitate maintenance by the detection and isolation of their own malfunctions or mistakes (diagnostic programs); upon which most other industries of the country and countless businesses, as well as science and space explorations, vitally depend; in which product and market developments seem almost kaleidoscopic when viewed from the outside; which appears unique in monopoly context by reason of its youth and apparent dynamics, but which by the same token in the ultramodern setting may be unprecedented also because of increased inducements for, and vulnerability to, sophisticated submarket control on the one hand, and massive industrial espionage on the other.

STATEMENT OF THE CASE—PRELIMINARY PROCEEDINGS

F2. This is an action brought by the Telex Corporation and Telex Computer Products, Inc ("Telex") against the International Business Machines Corporation ("IBM") in pursuance of Section 4 of the Clayton Act (15 U.S.C. § 15) to recover treble damages for alleged violations of Sections 1 and 2 of the Sherman Act, 15 U.S.C. §§ 1, 2, and Section 3 of the Clayton Act, 15 U.S.C. § 13. IBM counterclaimed against Telex for alleged unfair competition, theft of trade secrets and copyright infringement in reliance upon state law and 17 U.S.C. § 101 with reference to the infringement of copyrights.

F3. Telex's initial complaint was filed on January 21, 1972, in the United States District Court for the Northern District of Oklahoma (Action No. 72–C–18), alleging IBM's monopolization of, and attempts to monopolize, the worldwide manufacture, distribution, sale and leasing of electronic data processing equipment since 1954, and seeking damages in the amount of $238,290,000, trebled, injunctive relief, attorneys' fees, and costs. With the consent of the parties the issues and discovery for the purpose of these proceedings were limited to the United States.

F4. Concurrently with the filing of its complaint, Telex moved before the Judicial Panel on Multidistrict Litigation (JPML) in the matter entitled "In re IBM Antitrust Litigation", Docket No. 18, to transfer its case to the United

States District Court for the District of Minnesota for coordinated and consolidated pre-trial proceedings with Control Data Corporation v. International Business Machines Corporation, 3–68 Civ. 312, and Greyhound Computer Corporation v. International Business Machines Corporation, 3–70 Civ. 329 (N.D. Ill. 70C 2203), both of which were then pending in that court.[1] On February 1, 1972, Telex amended its complaint to describe in more detail its monopolization claims relative to the manufacture, distribution, sale and leasing of plug compatible peripheral products which could be attached to an IBM central processing unit. On February 25, 1972, Telex's motion to consolidate was argued before the JPML.

F5. On March 15, 1972, while its motion for consolidation was pending before the JPML, Telex filed a second complaint in the Northern District of Oklahoma (Action No. 72–C–89) alleging that IBM had violated Section 2 of the Sherman Act (15 U.S.C. § 2) by announcing its "Fixed Term Plan" in May of 1971 and its "Extended Term Plan" on March 1, 1972. Telex sought a temporary restraining order and preliminary injunction from the Oklahoma court. On April 19, 1972, the JPML issued orders transferring the Telex actions to the Minnesota court, Telex Corp v. International Business Machines, Inc., 342 F. Supp. 20 (1972), and Honorable Philip Neville, United States District Judge for the District of Minnesota, was assigned to handle complicated discovery and other matters preliminary to trials. Under his able supervision millions of documents were discovered or exchanged and photographed, and various procedural rulings made. On June 12, 1972, Telex filed a supplement to its complaint, alleging violations of the antitrust laws by IBM in the then soon-to-be-anounced IBM System 370/168 and 370/158 central processing units (CPU) with integrated CPU memory and integrated disk control circuitry and a lower priced incremental memory. Telex sought injunctive relief preventing IBM from integrating any memory or disk control circuitry into its System 370 central processing units and from lowering its prices for memory incremental to the CPU memory.

F6. On July 21, 1972, in partial response to a motion by Telex, the Minnesota court granted a temporary restraining order enjoining IBM from making any announcement of its 370/168 and 370/158 central processing units until the Minnesota court's decision on Telex's pending motion for preliminary injunction was entered. IBM sought relief from the Minnesota court's action in the Court of Appeals for the Eight Circuit (Docket No. 72–1447) both by way of appeal and extraordinary writ. That court on July 28, 1972, determined that the temporary restraining order entered by the Minnesota court was tantamount to the issuance of a preliminary injunction because it exceeded the ten day limitation set forth in Fed. R. Civ. P. 65(b). The Telex Corporation v. International Business Corporation, 464 F. 2d 1025 (8th Cir. 1972). It was ordered that the preliminary injunction be dissolved because the district court had made no findings relative to the ultimate probable success of Telex on the merits or on Telex's claim of irreparable injury. On July 28, 1972, Telex moved for a second temporary restraining order to be limited to ten days. That motion was denied on August 1, 1972. On October 6, 1972, the Minnesota court, after the submission of affidavits, evidentiary appendices and briefs, denied Telex's motion for a preliminary injunction as well as IBM's motion for summary judgment. After extensive pre-trial discovery on both sides in the Minnesota proceedings, Telex finally amended its complaint on January 2, 1973, to medand damages in the amount of $416,100,000, trebled, and on January 8, 1973, filed as amended consolidated complaint.

F7. Telex moved on January 9, 1973, that its cases be remanded to the Northern District of Oklahoma for trial. On January 10, 1973, the case was assigned to this Judge for final pre-trial preparation and trial. Telex's remand motion was granted on January 15, 1973, and as of that date, subject to the Minnesota district court's retention of jurisdiction on certain privilege issues, which have now been finally resolved, this court obtained jurisdiction of these proceedings. On January 22, 1973, IBM answered Telex's amended consolidated complaint and filed two counterclaims—one alleging unfair competition and theft of IBM trade

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[1] The *Greyhound* case was transferred to the United States District Court for the District of Arizona for trial. On July 10, 1972, IBM's motion for a directed verdict was granted at the end of the presentation of Greyhound's case. Judge Craig's opinion granting IBM's motion is reported at 1972 Trade Cas. ¶ 74,205 (D. Ariz.), —— F. Supp. ——. The *Control Data* case was subsequently settled and on January 15, 1973, Control Datas complaint was dismissed.

secrets, and the second alleging Telex's infringement of IBM copyrighted manuals.

F8. Pre-trial conferences were held before this court on February 20, March 30, and April 13, 1973. At the final pre-trial conference a jury, previously demanded on both complaints and the counterclaims, was waived by both sides. This court entered a final pre-trial order, based largely upon the March 30 conference, on April 12, 1973, which enumerated in detail the contentions of the parties, stipulated and disputed factual matters, the documentary evidence intended to be offered, and the witnesses to be called by the respective parties.

F9. Trial commenced on April 16, 1973, and the record was closed on May 24, 1973, after 29 days devoted to the taking of evidence. The expedition of the case consistent with full, fair and vigorous presentations was due in important measure to the ability, organizational talent, diligence and experience of counsel, together with the routine informal conferences held each morning before the convening of court among court and counsel where evidentiary problems were anticipated, presented and explored and the management of proceedings was otherwise charted from day to day. A brief post-trial conference was held on May 25, 1973. The parties submitted their separate proposed findings of fact and conclusions of law in compliance with the request of the court, and on June 18 and 19, 1973, oral arguments were had. Whereupon the case was submitted for decision and by the court was taken under advisement.

The court, now deeming itself fully advised, makes the following Findings of Fact in addition to the statement of the case and proceedings set out above, and the minute stipulated facts not set out, but incorporated herein by reference since there is no contest with respect to them.

I. THE PARTIES

F10. International Business Machines Corporation (IBM) was incorporated on February 24, 1924, and maintains its principal place of business in a state other than the State of Oklahoma where plaintiffs are incorporated and maintain their principal places of business. Before its entry into the electronic data processing (EDP) industry, IBM manufactured punched card accounting machines and other products. In addition to its EDP business, IBM develops, manufactures and markets other business machines including copiers, dictating equipment, and electric typewriters. IBM has been deeply involved in the phenomenal growth of the electronic data processing industry since almost the beginning of the industry. IBM's first EDP system offered for sale was the IBM 701. The first IBM 701 was completed in April of 1953 and was intended primarily for scientific work in connection with nuclear research. The first IBM computer intended for commercial work was the IBM 702, which was installed in early 1955.

F11. The Telex Corporation was incorporated in February, 1963. It is the successor to Telex, Inc., which was incorporated in May, 1940. Since at least 1959 Telex has been manufacturing products which have been used by electronic data processing equipment manufacturers as part of their equipment.

F12. Because of the success of IBM's System 360, certain companies such as Telex entered into the marketing of devices functionally equivalent to IBM devices. The devices marketed by Telex and others plugged into and replaced parts of the System 360. In 1966 Telex began to market replacements for the magnetic tape devices which were part of IBM's System 360 computers. Before the receipt of a contract with DuPont to replace DuPont's installed second-generation IBM magnetic tape devices, Telex had been conducting engineering development work to modify the Telex Model M3000-a magnetic tape drive then being marketed by Telex to other EDP equipment manufacturers—to provide an appropriate electronic interface to attach to an IBM central processing unit (CPU). An interface is a shared boundary between electronic data processing machines, or more accurately between the channels or physical pathways connecting those machines, through which data or programs may be transmitted, received, stored or processed. After receipt of the DuPont contract, the work was completed and the equipment delivered in August, 1966. The Telex-developed machine was designed with an electronic interface to work in conjunction with an IBM CPU. It was designated as Telex's Model 4700. In late 1966, additional 4700's were installed at Lockheed Aircraft and at Electronic Business Service (AMI). The total engineering cost for designing the electronic interface necessary to adapt Telex's tape drive for use with IBM equipment was $42,000.

F13. In May, 1969, Telex began to market replacements for IBM's disk drives. Telex does not manufacture but purchases the disk drives and disk drive con-

trollers from another company. In November, 1970, Telex announced that it would begin marketing a printer and a printer controller. The printer mechanism is not manufactured by Telex but is purchased from Control Data Corporation. Telex manufactures some of the printer electronics and the printer controller. In November, 1971, Telex announced it would offer a replacement for the memory or main storage used with certain IBM systems. In November, 1971, Telex announced a 6360 memory for attachment to IBM Systems 370/155 and 370/165. That memory was first delivered in November of 1972. Telex purchases the parts of the memories from various corporations. It assembles the parts and markets the final product. As of January 26, 1973, Telex had installed two memories. In November, 1971, Telex announced a 6345 memory for attachment to an IBM System 370/145. Telex has not yet delivered any 6345 memories. Telex has recently advertised its intention to announce a memory for attachment to IBM Systems 370/168 and 370/158. Telex's forecast for first customer delivery for these products is the fourth quarter of 1973.

F14. Telex has never announced or delivered a "communications controller" but is presently developing a plug compatible communication controller equivalent to IBM's 3705. Telex has negotiated an agreement with Hitachi, a Japanese corporation, under which Telex will engage in a joint development effort to develop a CPU compatible with IBM's System 370 and competitive with System 370 Models 135 and 145. No final decision has yet been made as to the actual manufacturing and marketing of such a product.

F15. In the aspect of its business relating to the marketing of EDP products to IBM end-users, Telex in the past has had a company policy generally of following IBM's product leadership and subordinating any technological product innovation. Telex products are designed as the functional equivalent of previously announced IBM products, except for whatever technological advances Telex is able to introduce because of the later announcements of its products. Telex's plug compatible tape drives, disk drives and printers have had better performance in some respects than IBM's corresponding products.

F16. Since entering the EDP industry and up to 1971, Telex reported a phenomenal growth in revenues. Its revenues from EDP products and services sold to customers within the United States as reported in the "census" [2] rose from $870,000 in fiscal 1967 to $56,840,000 in fiscal 1971.

II. THE INDUSTRY

F17. The electronic data processing (EDP) industry is a young and dynamic one ranking high in importance among the industries of the nation. The first commercially built EDP system—the Univac I—was delivered in 1951 to the Bureau of the Census. The demand for EDP products and services as indicated by the revenue of companies responding to the court census has grown from $48 million in 1952 to $10.2 billion in 1970.

F18. Electronic data processing is employed by government and major producers of goods and services throughout the country to make their operations more efficient and to provide new and better products and services. The scientific community has used and is continuing increasingly to use electronic data processing extensively. The kinds and types of available products, equipment or services used are determined by the applications for which there is a need and the available resources to meet the need. Examples of electronic data processing applications are almost as numerous as business and scientific applications: The computer can keep track of enormous numbers of people who have made reservations with the various airlines and tell passenger reservation agents when planes are full. EDP systems control many manufacturing processes and almost entire factories, monitor patients with severe heart disease in hospitals, and control some navigational systems on airplanes. Such systems are used in printing newspapers, controlling traffic lights, guiding ships, navigating and controlling space missions, and even in designing other computers. Less dramatic

[2] The "census" refers to the responses of 1,786 companies to Rule 31 depositions upon written questions ordered taken by the United States District Court for the District of Minnesota for the purpose of obtaining information concerning the EDP industry. The depositions were taken in pre-trial discovery proceedings relating to several cases, including Telex v. IBM, which had been consolidated in the Minnesota court with Control Data Corporation v. IBM, Civil Action No. 3–68–312. Rule 31 Depositions were sent to approximately 3,300 companies and about 2,700 responses were received. About a thousand responses were eliminated either because the companies responding were very small or because the answers were not responsive or were otherwise not susceptible to recordation. This census is in evidence.

but widespread are day by day business applications affecting the lives and fortunes of almost every individual in the country in one way or another. There has been a marked increase in the sophistication of EDP customers in the last few years. Immediate purchasers of EDP products and services are most often large institutions such as the United States government, universities, or large industrial organizations. Most of the EDP systems are installed in the five hundred largest governmental and business organizations. Many professional consultants offer assistance in the design of EDP systems and the procurement of EDP products and services, thus enabling smaller users to make more knowledgeable decisions concerning their EDP needs.

F19. Dramatically increasing demands for EDP products and services and the needs of EDP users have resulted in a rapid growth in the number of companies which offer EDP products and services and in a variety of products and services which are offered to accomplish the data processing needs of users. Many different kinds of companies have been attracted to the EDP industry. The number of companies responding to the census and reporting EDP revenue in each year from 1952 to 1970 has grown from 13 to 1773, a growth in number of more than 136 times in eighteen years. According to the census, the number of companies which manufacture and market a complete EDP system has grown from 3 in 1952 to 96 in 1972, but only 8 or 9 of these companies are considered in the trade as principal systems manufacturers. These include IBM, Univac (Sperry Rand), Burroughs, Control Data Corp., General Electric, Honeywell, RCA, XDS (Xerox), NCR, and Digital Equipment Corporation (DEC). Recently RCA and GE have gone out of the systems business.

F20. Spurred additionally by the success of IBM's System 360, manufacturers of certain peripheral devices began in 1966 to market to end-users products which were functionally equivalent to certain IBM System 360 devices. The equipment of these companies "replaced" IBM devices and utilized all the system's support and services provided by IBM. In 1966 Telex, and shortly thereafter other independent manufacturers, began manufacturing and operating magnetic tape drives which were functionally equivalent to IBM magnetic tape drives and which could be "plugged" into, and thus were "plug compatible" to IBM central processing units. The end-user customer of an IBM computer system then had the option to use an IBM tape drive or to use one made by a "plug compatible manufacturer" (PCM). Peripheral equipment manufacturers have expanded their peripheral product lines, moved into the leasing of complete EDP systems, and certain of those companies, including Telex, Memorex and Mohawk Data Sciences, are now expanding, or considering expanding, into the manufacture and marketing of their own central processing units.

F21. In the mid-1960's leasing companies began purchasing computer products from IBM, which they then leased to computer end-users. These companies purchased $2.6 billion worth of IBM's 360 computer hardware for which IBM received its full retail price and corresponding profit. Leasing companies typically purchase an installed IBM computer system and then lease it to the existing end-user at a rate less than IBM charges for its identical products. When an initial lease ends and the machine leaves the first end-user's shop, the leasing company owner remarkets the "used" equipment when possible. Another type of leasing company transaction involves the purchase of plug compatible tape and disk drives from PCM's after they are installed and on rent in an end-user's location. This type of transaction is primarily a method of financing and the leasing company depends upon the manufacturer to market and service the product.

F22. A service bureau owns or leases computer products and/or services and then performs data processing services for customers for a fee. The customers can get data processed by this method without owning or leasing any specific EDP "hardware" or "software". A time-sharing company is one that installs a terminal facility in the customer's business location; the terminal is connected to the time-sharing company's computer system via telephone communication lines. The end-user can then time-share the computer system by means of the remote terminal for a fee. A data center is an establishment having a computer installation which permits customer personnel to operate the computer equipment for a fee. Software houses prepare and market computer programs or instructions designed to cause the central processor and peripheral products to peform their required functions. Examples are instructions that will cause data from input devices to be transferred to storage devices, to be retrieved when needed, then processed in a usable form. Facilities management companies, or system engineer-

ing consultants, such as Computer Usage Corporation, provide the customer with systems engineering and design services as well as services for the actual operation of the end-user's computer facilities.

F23. The speed, reliability and capacity of computer products have increased greatly since 1952. One of IBM's CPU's, the 370/168 (announced but as yet undelivered) when compared to the Univac I will have 700 times the storage capacity of Univac I, and it will execute additions 4,300 times faster, multiplication 3,100 times faster, and division 2,000 times faster. The data transfer rate of current tape drives is 40 times greater than that of the earliest tape drives used with the Univac I. Memory technology has increased cycle speed of main memory devices a thousandfold since 1952. Electronic circuitry improvements permits products to be made today which were difficult to conceive a few years ago. Speed, capacity and reliability have improved, while power requirements have dropped.

III. THE NATURE OF ELECTRONIC DATA PROCESSING

F24. Electronic data processing (EDP) is the conversion of words, letters, numbers or combinations of words, letters and numbers, or other types of data, into electronical signals; the data is then collected, stored, sorted, analyzed, compared or computed. The "hardware" products and "software" programs that perform these functions are often referred to collectively as a computer system, or simply as a computer. Computing may involve both simple and complicated calculations, or the storing and sorting of large amounts of data. An example of the complicated calculations of computers is the work done at the Manned Spacecraft Center which links computer systems throughout the United States to computers on board spacecrafts to perform large numbers of precise, complicated calculations. An example of storing, sorting and comparing large amounts of information is an airlines passenger reservation system, or a warehouse inventory system.

F25. An EDP system consists of products which perform five basic functions. These are "processing", "storage", "input", output" and "control". Input is the entering of data into storage. The input devices convert data from an "ordinary" language form (i.e., English and numbers) to "machine" language or electronic signals which are then understandable to a computer. Output is the opposite. Output devices convert the "machine" language or electronic signals to the output form desired, such as printed or typed in humanly understandable language on paper, recorded on magnetic tape or magnetic disk, punched as a hole in a punched card, or displayed on a television-like screen. Output devices can also be used to open or close a valve, or to transfer electrical impulses to another computer system. Storage of data is accomplished in either the main memory or some type of auxiliary storage.

F26. Main memory is the storage from which data are transferred to the processor and to which data are returned in their processed form. Auxiliary storage is the storage from which data are interchanged with the main memory for processing, temporary transfer, or more permanent storage. Auxiliary storage is usually accomplished in some one or more of the following: Large core storage (LCS), data cells, magnetic drums, magnetic disk devices, magnetic tape devices, paper tape devices and punch cards. The type of auxiliary used is dependent upon the applications and needs of the customer with reference to the stored data.

F27. The processing function is the computation or performance of logical operations. These logical operations involve additions, subtractions, and comparisons. The logic is composed of single steps done rapidly to achieve the ultimate results. A control function enables a computer system to perform a large number of consecutive instructions. The control function can usually understand or evaluate the various operations as they are concluded and perform alternate operations without human intervention based upon such evaluation. The control function directs and coordinates the operation of the various products making up the system and can be performed by a combination of hardware, microprogramming and software. Programs are sequences of instructions which tell the various devices what to do. Programs are also referred to as software.

F28. A modern computer system is composed of a variety of individual devices each of which usually performs a different function that may be needed to perform a particular needed application. The user may select from various products the particular combination of inividual devices and software which will

solve the customer's data handling needs, taking into consideration the economics and applications involved. The user's choice of alternative devices may depend upon trade-offs among price, capacity, speed, flexibility, space requirements, and the number, kind and priority of applications to be performed and users to be serviced, but inherent are various limitations of functions and application which as a practical matter most often dictate a particular device for a particular application.

F29. Individual input/output products include teletype machines, typewriter terminals, television-like displays which use cathode ray tubes, card punches and punched card readers, magnetic tape drives and magnetic disk drives. There are also devices which read magnetic characters or optical characters such as those on checks, and there are devices which read coded tags on merchandise. When used in stores, these devices automatically record the sale, bill the customer, and remind the store to reorder.

F30. Printers perform an output function. Like a typewriter terminal, a printer converts electrical signals into printed characters and numbers. Printers, however, operate at much higher speeds than typewriter terminals. Mechanical input printers operate at up to 2,000 lines per minute while electrostatic printers, which operate similar to copying machines, can operate at higher rates. There are special purpose printers used to produce graphs, charts, drawings and maps. Other output devices produce microfilm. These are called computer output microfilm, or COM, devices.

F31. Products which perform a storage function include magnetic core arrays, semiconductor circuitry, magnetic tape drives, magnetic strip files, magnetic drums, and magnetic disk drives. All these devices, except the semiconductor circuity, store data by converting electrical signals into a magnetized recording that can be reconverted into electronic signals. A magnetic recording is permanent in that it remains when electric power is "off", but the semiconductor circuit loses its stored data when the electric power is "off".

F32. The CPU is generally where most of the logical functions or calculations are performed. Controllers, channels, peripheral processors and multiplexors are smaller processors designed for a particular use, and when used permit a more efficient use to be made of the central processor by speeding up interchanges of data and making preliminary or intermediate computations for relay to the CPU.

F33. EDP products are built from electronic and electrochemical components. The components include electronic circuits, devices for converting electrical impulses to magnetic, devices for converting magnetic impulses to electrical, devices for converting electrical current to mechanical movement, as well as cables, connectors, metal frames and various power and cooling elements. The most numerous physical parts of an EDP system are the electronic circuits. Electricity, as used in a computer, essentially has only two states or conditions—it is either "on" or "off" as is the case of an electric light. By combining electronic switches which are on or off, computing can be done if "on" equals 1 and "off" equals 0. Different combinations and sequences of 1's and 0's then can be used to represent all numbers and all letters. When electronic data processing began, each electronic circuit was made up of a vacuum tube, such as is used in radio or television, plus wires and resistors. The development of transistors in the 1950's allowed the vacuum tubes to be replaced by transistors.

F34. IBM was an early user of the transistor in its EDP systems. IBM built its own factories to make transistors. The use of transistors made possible the reduction of size, cost and power requirements of an EDP system and increased reliabiilty and speed. This allowed the construction of EDP systems of greater capacity and operational speed and expanded the number and types of applications for which such equipment could be used. As work continued on the refinement of the transistor at places like Bell Laboratories, Texas Instruments, Motorola, Fairchild, and IBM, ways were found to combine the various components making up an electronic circuit into a single chip, which is now about 1/8 inch square. This chip is called an "integrated circuit". In the 1960's, IBM as well as others began to build EDP systems using integrated circuits. This allowed a further reduction in size, a further increase in reliabiltiy, a further increase in speed and a further reduction in cost. Work at IBM and other places has led to the continual miniaturization of the circuits. It became possible to produce multiple circuits on a chip. This was referred to first as "medium-scale integration" and later, as the number of circuits increased, "large-scale integration". In the latest EDP equipment, components are in use which have more than two

thousand circuits on a single silicon chip ⅛ inch square. Under development in IBM and other laboratories are chips containing 16,000 circuits. Moreover, there are under development processes which, it is believed, will produce chips with 64,000 circuits or more.

IV. RELEVANT MARKET

F35. In determining whether there is monopoly power to control prices or exclude competitors in any part or line of commerce, the court is required to consider a relevant market or markets within which such determination can be made. Manifestly, the electronic data processing market in general is one relevant to such an inquiry. But the fact that monopoly power may not exist on the part of any company within that general market as a whole does not end but only begins the inquiry in this case. It should also be noted that we are not primarily concerned with prior or subsequent years, but that in view of the issues of this case a determination must be made as to the relevant market or markets in the period 1969–1972, timing also being an important element here because of the youth and dynamics of the market and its various developmental stages over the years. It is recognized that a purely transitory condition could be so brief or insubstantial as to be *de minimis* or immaterial in appraising market power; but it must also be recognized that in a real sense every market condition may be temporary in the perspective of historical development, and yet the policy of the antitrust laws does not permit the unlawful application of monopoly power against competition to its damage over a substantial period even though, if competitors could hang on for a time, technological or other developments might change the competitive situation for the better.

F36. Telex asserts that in the period mentioned IBM possessed monoply market power in the general systems (CPU) "relevant market", in the market for peripheral devices plug compatible with IBM CPU's, and in the "relevant submarkets" for magnetic tape products, direct access storage products, memory products, impact printer products, and communication controllers that were plug compatible with an IBM CPU. IBM claims that it had no monopoly power in any such general markets and that submarkets did not exist because competition in the EDP industry was primarily on a systems basis, and that the relevant market consisted of EDP systems and the products which make up such systems and the companies which provide alternatives to such systems. IBM further claims that even if one were to limit the focus to particular parts of a system, such as peripherals, the relevant market must include all peripheral products, not just those currently attached to IBM systems. It is further contended by IBM that once the decision is reached that the relevant market should include peripherals attached to competitive systems, as well as those attached to IBM systems, it does not make any difference with respect to IBM's share whether the market is limited to such peripherals or is broadened to include all products which make up systems. IBM further claims that even if "plug compatible" tapes, disks, printers, communications controllers, and memories did constitute separate submarkets, if the decision were made to include disks or any of the other products attached to known IGM systems, as well as those attached to other than IBM systems, IBM's share of each of these submarkets would be well below the level that would support any inference of market power.

F37. The potential general market toward which the efforts of both companies seem directed, with the progressive broadening of Telex's base and the technological and industrial developments in prospect, appears substantially the same, and the real issue is whether that market may be realistically subdivided in the time frame 1969–1972 to focus on and encompass only those parts of current product lines which are respectively attached to IBM systems, rather than all those products which actually have similar uses in connection with other systems; although, with respect to the claimed *attempt* to monopolize, these distinctions may not be critical. By definition every manufacturer has 100% of its own product. Thus, where a hopeful competitor first offers a product as a substitute for the original, the originator typically will continue to have a large share share of that product. So, likewise, in the EDP industry each manufacturer of systems normally has a large percentage of the peripheral equipment which is part of its system. By this token a systems manufacturer has 100% of the peripheral attached to its new system until someone begins to copy some or all of these peripherals or designs others to take their place on a plug compatible basis. It is an over-simplification to say, however, that under Telex's market definition theory, as soon as someone begins (or perhaps even plans or thinks about) copy-

ing a part of a new system, as IBM argues, the manufacturer of that system becomes monopolist and has an obligation not to cut prices or do anything else that might reduce the profitability of the copier.

The record in this case shows that peripheral devices attached to IBM equipment but manufactured or supplied by others during the relevant period have grown into, and have been recognized as, a significant, distinct and important part of the EDP industry. Again, for the particular period mentioned, we are not dealing with mere theory but with a historic, economic fact, transitory or otherwise. The question persists, however, whether such suggested subdivisions of the industry can properly be regarded as relevant markets or submarkets within which economic power can be separately appraised. A related dilemma must be avoided by at once precluding the unreasonable fragmentations of markets[3] and preventing the monopolization of separately competitive components while a whole industry is thus subverted part by part.

F38. Peripheral products constitute an important part of a data processing system, accounting for 50–75% of the price of the system. Such products are critical to the performance of the system as a whole. It cannot be gainsaid that indirectly at least and to some degree the peripheral products attached to non-IBM systems necessarily compete with and constrain IBM's power with respect to peripherals attached to IBM systems. The quality and price/performance of the peripherals attached to a system are a substantial factor in a customer's choice between competing systems, and if for example IBM failed to improve the price/performance of its peripherals, customers might choose systems (including peripherals) of other systems manufacturers. Peripheral pricing and product announcements of one systems supplier influence subsequent peripheral pricing and product announcements of other systems suppliers, although it may be difficult to identify any given competitive price cut or product improvement as a reaction to a single competitive act. Many companies, including Telex, which manufacture or market peripheral equipment for attachment to IBM CPU's also manufacture or market equipment for attachment to non-IBM CPU's, but to a substantially lesser extent. Moreover, suppliers of peripherals plug compatible with non-IBM systems could in various instances shift to the production of IBM plug compatible peripherals, and vice versa, should the economic rewards in the realities of the market become sufficiently attractive and if predatory practices of others did not dissuade them. In the absence of defensive tactics on the part of manufacturers of CPU's, the cost of developing an interface for a pheripheral device would generally be about the same regardless of the system to which it would be attached, and such cost has not constituted a substantial portion of the development cost of the peripheral device.

F39. In this extraordinary industry dominated as it has been by IBMs influence neither theoretical relationships nor technological similarities supply the full answer to the relevant market problem. In the realities of the marketplace, as recognized and acted upon by IBM as well as by the plaintiffs and their customers, it must be determined (a) whether plaintiffs' concept of relevant markets keyed peculiarly to devices plug compatible with IBM CPU's is sound, and (b) whether there is sufficient demand or supply interchangeability, substitutability or flexibility as to render indistinct or ineffectual the lines dividing the submarkets relied upon by plaintiffs as among themselves or as between them and general EDP systems. A differentiation between the IBM plug compatible peripheral market in general and submarkets involving particular types of such peripherals seems not so critical, since it appears likely that IBM's market power would not significantly vary as between them.

F40. IBM and other systems manufacturers design, develop, manufacture and market system solutions to data processing problems on a systems basis primarily, although with respect to particular applications the suitability of particular peripheral equipment may be emphasized. In designing a system, IBM and other systems manufacturers must design the boxes comprising the system, the configuration of boxes in the system to provide the best solution to a particular set of requirements, the system software essential or helpful for the operation of the hardware generally, and the particular applications software to perform the customer's special applications. The reliability and predictability of the system involve the hardware, software and the personnel maintaining and

[3] IBM states: "Obviously a finding that the relevant market could be as narrow as suggested by plaintiffs would have broad implications for IBM, for the EDP industry generally and perhaps for many other businesses as well. Indeed, if Telex has a good claim against IBM it should have an even better claim against Univac who's acquired RCA CPU's, Telex's tape drives attached through Formation controllers. Such a broad and novel impact suggests that the reasoning that leads to such a result may be faulty; indicating that the appropriate market must be broader than plaintiffs contend."

operating the system. There are significant expenses involved in designing systems so that the various boxes can be integrated into different configurations and combinations. There are a number of other systems development costs not easily identifiable because of difficulty in segregating an engineer's time between developing a particular unit and working on its integration into a system. Similarly, systems marketing costs are hard to define because of the difficulty of separating the time a salesman spends configuring a system from his other activities. Particularly with respect to new customers, systems manufacturers offer a substantial amount of EDP education, which is essential in order to market systems. Systems development and marketing costs are allocated across all of IBM's products and are included in the pricing of those products. Some customers can perform completely their own systems integration work in view of the level of sophistication among them, but others rely upon IBM or other systems suppliers to do this work and to provide systems control programs. Telex and other peripheral manufacturers do not incur substantial systems development and systems marketing costs in connection, with their plug compatible business, nor could they market their products for attachment to IBM systems without IBM system software to which is devoted about 30% of IBM's annual development cost. Thus there are practical and logical difficulties in severing the peripheral market from the systems market.

F41. It is true also as a generalization that to a substantial degree each of the different functions of a system can be and is performed by a variety of devices and that users not infrequently can choose among different devices which make up an EDP system on the basis of price/performance and the particular applications desired. This interchangeability, however, is between particular peripheral devices for particular applications, and in and of itself does not render particular devices a necessary part of a systems market. Rather, it raises the question whether all or a portion of the peripheral devices are a part of the market for peripheral devices. Merely because there are alternate ways of storing data in an EDP system, each of which competes to a degree with others in various applications, does not mean that it is appropriate to consider storage products such as tapes, disks and memories and their substitutes as a part of the systems market rather than part of a peripheral device market.

F42. Devices which perform a storage or memory function include core arrays, semiconductor circuitry, magnetic tape drives, magnetic strip files, magnetic drums, and magnetic disk drives. Each of these devices has a different operational speed and a different cost and, depending upon the needs and budget of the user, each can be used in structuring the computer in different ways to a limited extent. Constrained by particular applications, needs and objectives, these devices compete with one another in a limited sense and in some applications users can employ different devices interchangeably. An EDP user might "trade off", for example, the higher performance of memory for the lower price of disks in certain applications, whereas for other applications disks and tapes could perform similar functions and be used interchangeably. A user might trade off the higher performance of magnetic disks or drums for the lower price of magnetic tapes on some applications, and in general, but still in a limited sense, users may have price/performance alternatives or trade-offs among disk drives, memory, tape drives, the tape library, the vault, the disk pack, etc. in configuring any total EDP system. In a limited sense, too, certain storage devices such as memory are interchangeable with the CPU itself, users choosing between larger or faster CPU's with relatively small amounts of memory and smaller or slower CPU's with relatively large amounts of memory; and in certain instances CPU's function as peripheral devices, and peripheral devices or parts of peripheral devices have similarity to CPU's. Terminals which perform input and output functions also have processing functions, storage functions and control functions. Intelligent terminals perform processing functions otherwise performed by communications controllers or central processing units. Most magnetic core storage, magnetic tape drives, magnetic disk drives and magnetic drums contain some processing control functions. Printers, like Telex's 5848, can also perform processing storage functions with a controller and magnetic tape drives.

F43. The users also choose between terminals, printers and computer output microfilm devices as various means of accomplishing an output function depending upon the various needs and applications involved. Special kinds of printers, called plotters, can be used to produce graphs, charts or drawings, and even maps. Other types of printers called computer output microfilm (COM) devices produce microfilm. A teletype is one kind of slow speed printer. Other kinds

of printers include drum printers, which can be slow or high speed (from 300 to over 1000 lines per minute), chain printers and train printers. Less expensive slow speed printers are alternatives to more expensive higher speed printers. Terminals are also used to perform output functions. Electrical signals are converted into words and numbers on a display screen or typed on a roll of paper. Many terminals also have processing functions, storage functions and control functions. Computer output microfilm may be a direct competitor to printers because of relative hardware costs as well as cost of paper versus cost of microfilm, and some customers have replaced or are replacing printers with COM equipment on a price/performance basis.

F44. An essential element of any electronic data processing system is the control function. In large portion the control function is performed by software or programming. The cost of developing operating system software is substantial and competition in the supply of better operating systems necessarily affects the price a manufacturer can charge for its EDP systems. But it is true only in the superficial sense that software can be used as a direct substitute for hardware, although cost of certain hardware or the extent of its necessity may be affected by the software.

F45. Some suppliers of peripheral devices can and do become suppliers of systems and the suppliers of full systems can and do supply peripheral devices plug compatible to the CPU's of other manufacturers in some instances. Suppliers of peripheral devices, including Telex, either have planned or are considering movement to full systems. Texas Instruments, which began as a supplier of components for EDP and other electronic purposes, now markets the world's fastest CPU, and Memorex, which began as a supplier of peripheral devices, announced two full EDP systems in 1972. Suppliers of full systems, including IBM, can and in some instances do provide peripheral devices for use with the systems of other manufacturers either directly to end-users or to other system manufacturers. Manufacturers of CPU's and peripherals use to a substantial degree the same technology, making it technologically practical given time, funds and personnel, to switch from one to the other. In the long range this potential "supply substitutability" has had and will have substantial effect upon the development of the market and upon trends of competition, but during the period with which we are concerned supply substitutability was a minimal factor in the marketplace as a constraint upon pricing. It was a fact of economic life in the industry that new technological developments and new entries into the market were continuing, but the primary factor which governed the pricing of peripherals for entrance into the peripheral market was the demand elasticity or the substitutability of immediately available products in connection with the needs and applications of users.

F46. Computer equipment is different than used automobiles because when properly maintained such equipment generally performs as well today as it did when new, subject to repair and subject to obsolescence through technological advances. Various end-users view leasing companies as a competitive alternative and in many instances may substitute leasing company equipment for installed IBM equipment. Telex itself leases full systems to users, including IBM CPU's, and purchases certain peripheral equipment from other manufacturers and remarkets it to end-users. Service bureaus, time-sharing companies and data centers are also used by customers to a degree as alternatives to acquiring new or additional EDP systems. An EDP user may obtain his own equipment, may have his data processing done by establishments such as service bureaus, data centers and time sharing companies, or he may purchase time from another user. Some EDP end-users consider service bureaus, data centers and time purchased from other users as practical alternatives to acquiring new equipment. But with respect to peripheral equipment to be added to or integrated with IBM CPU systems, these alternatives have not provided substantial constraints on IBM's product and pricing decisions.

F47. Systems manufacturers offer central processing units and peripheral products which are electronically compatible to each other. The peripheral products designed to be compatible with one manufacturer's central processing unit are not interchangeable or attachable to the central processing units of another manufacturer without modification of their interfaces. As a practical matter, there is no direct or box for box competition between IBM's peripherals and the peripherals of other systems manufacturers, and in order to replace IBM peripherals with the peripherals of another system manufacturer, the user must first replace his IBM central processing unit. The only box for box peripheral competition of any substantiality has been and is between IBM

and the plug compatible manufacturers (PCM's). IBM's Systems competitors were not directly affected by IBM's pricing and product actions for peripherals and made no competitive price responses to IBM's 2139A and B and Fixed Term Plan (FTP) price reductions for its peripheral products. After FTP, IBM's Systems competitors were not mentioned in any of IBM's FTP tracking documents as having cut or reduced their price for any of their products. Time sharing companies, service bureaus, and data centers, were not directly affected by IBM's price and product actions for peripherals, and after 2319A and B and FTP made little if any competitive pricing responses to IBM's peripheral price reductions.

F48. IBM markets its product by both lease and sale. All sales to end-users or leasing companies are at IBM's full retail price. IBM determines its retail sale prices by establishing a monthly rental multiple for the product that is equivalent to the number of months of rent that IBM reasonably expects to receive for that product. The rental-sale multiple for each machine may be different—based on the estimate of product life. When IBM is paid the full economic value of a product sold, it expects the product to be used for its full product life. Peripheral products separately leased by other companies or by IBM are not numerous, and leasing companies most generally lease systems or a combination of peripherals and CPU's. There is a substantial amount of IBM equipment owned by leasing companies. The pricing of leasing companies is constrained or affected by IBM's pricing policies, which may neutralize to an extent the competitive effect of leasng company activities as to IBM pricing.

F49. The court has not been unmindful of these and other circumstances and arguments pressed upon it by IBM in attempted demonstration that since its predatory acts or market power have not been proved in respect to the EDP industry or the systems market as a whole, it cannot be vulnerable to a charge of monopoly by reason of the interrelationship among components of the industry. Some practical considerations among other more imponderable ones militate against such a theory: (1) The pattern for a divide and conquer strategy of monoply which its acceptance would permit and foster, and (2) in the realities of the market and of competitive conduct, neither IBM, its competitors nor the public have experienced difficulty in subdividing the EDP industry into markets roughly equivalent to the classification contended for by plaintiffs. IBM recognized as early as 1964 that a separate and distinct market for input/output peripheral products that were plug compatible to IBM central processing units was developing. For several years IBM studied possible market and product actions which would minimize potential entry of new competitors into that market. Plug compatible manufacturers have been defined in IBM internal documents as "those manufacturers which merely have to plug into IBM hardware to be operable".

F50. In late 1969 "peripherals" were designated as a "key corporate strategic issue"—(KCIS")—by IBM's management committee. The key peripherals issue was limited to selected competitive compatible products which replaced IBM products in an IBM computer system. In IBM's internal processing and study of this issue "competitive compatible products" were described as "system attached input/output and memory products" including "magnetic tape drives and control units—direct access storage products and control units—impact printers and control units." Memory products were both "main" and "large capacity storage". Excluded were central processing units, consoles, paper tape products, communication products and control units, information display products and control units, RPQ's and non-standard products, and non-system attached products. The objective of designating peripherals as a KCSI was to assess the factors affecting both current and future competitive compatible peripheral products: to review IBM strategies, policies and practices so as to identify exposure areas; and to recommend actions to reduce or eliminate such exposures. These plug compatible products were treated by IBM for competitive studies, strategies and other purposes as separate economic entities. And, particularly, IBM recognized for said purposes central processing units, memory products, consoles, paper tape products and control units, communication controllers and related communication products, magnetic tape products and control units, direct access disk drives and subsystems, and impact printers and control units, as separate economic entities. This separate consideration and treatment no doubt is ascribable in part to convenience of record keeping, comparison of data, effectiveness of evalaution and such factors, but with reference to memory products, magnetic tape products and control units, direct access disk drives and subsystems and impact printers and control units, in view of the competi-

tion of other marketers furnishing devices plug compatible to IBM machines, such suppliers, IBM and the industry in general came to regard these lines especially as representing separate economic entities as a result, and for the purpose, of actual competition in the marketplace.

F51. IBM's 2319A–9 product and marketing actions hereinafter discussed affected and were intended to affect directly only one type of product, its 2314 type equipment, and were particularly intended to reduce profits for Telex and Memorex on this type of product. The only IBM products forecasted by it to be protected by IBM's Fixed Term Plan (FTP) was IBM's tape, disk, and printer products. The only competitive products forecasted by IBM to be affected by FTP were plug compatible manufacturers' tape, disk and printer products. When, as here, predatory action is selective and focused, and its anticompetitive effects are similarly shunted away from a more general market, corresponding submarkets should be more readily recognized. IBM has made the persuasive argument that a market concept based on the idea that every manufacturer has a monopoly in each of the components of its prduct is too sweeping, and necessarily flawed, the flaw being "the disregard of economic forces operating in the markets where manufacturers compete." With such a generalization there can be large agreement. But the critical flaw in application to the circumstances of this case, it seems to me, would be created by ignoring the separate market and submarkets within which IBM waged its predatory competitive battles and which became and were thereby made separate competitive entities in the marketplace and within which monopoly power existed and was exercised.

F52. The court finds that the peripheral devices plug compatible with the CPU's of IBM may be considered the relevant market for the purposes of this case, and that relevant submarkets existed for plug compatible tapes, disks, memories and printers with their respective controllers, and communications controllers.

F53. CPU's are not reasonably includable within this market and these submarkets, nor are software as such, but the peripheral equipment plug compatible to IBM CPUs' which are separately leased by leasing companies to end-users are. Alternate sources of computer time such as service bureaus, time-sharing companies, data centers, users selling excess time and the like are not reasonably includable in the relevant market or submarkets with which we are concerned in this case, since their competitive relationships are tangential and indirect, and do not supply a real or substantial competitive force in the relevant markets mentioned. It is true that a large part of the competition in the industry takes place on a systems basis, but the relationship of this competition to the relevant markets with which we are concerned again is tangential and practically indiscernible. Certainly in another context the competition between systems manufacturers would constitute, or be a part of, a relevant market, but such relevant market is not material under the facts of this case since the competition involved here is not between systems manufacturers but between IBM and plug compatible manufacturers and suppliers.

F54. Nor do the alternate ways of storing data in an EDP system justify the commingling or combination of submarkets. The evidence indicates that objectives and applications are the controlling factors in the use of alternatives and not necessarily price. While in special instances price may have affected particular selections as between alternatives, the applications and objectives of an operation have dictated not only the selection but the price/performance ratio itself in most instances. It is more theoretical than real to say that interchangeability of use or demand as between tapes and disk storage, for instance, precludes the consideration of these submarkets separately. Nor do the trade-offs possible as between the higher performance of memory for the lower price of disks avoid these practical consequences. It is true that if memory were less expensive the user might extend the use of memories for the storage function rather than to utilize disks to the extent he does. This does not obviate the competitive reality that as between disk drives and memories a valid submarket boundary line exists. The reality of this situation appears to be that despite some theoretical interchangeability, a rise in the price of one storage device will cause a substantial number of customers to turn to similar devices less expensive rather than to use fewer of such devices and more of other types of devices. It is true, also, that to some extent certain storage devices, such as memories, are interchangeable with CPU's themselves, and that users can and do choose between larger or faster CPU's with relatively small amounts of memory and smaller or slower CPU's with relatively large amounts of memory.

In the realities of the marketplace this, however, has not critically affected the competition between suppliers of memory or disk products compatible with IBM CPU's, nor does the circumstance of theoretical interchangeability mean that both CPU's and memory belong in the same relevant market.

F55. The foregoing determinations have been made, it is believed, with due regard for the authorities concerning interchangeability of use, cross-elasticity of demand and supply substitutability, and defendant's arguments based thereon. Mere theoretical cross-elasticity without substantial impact in the marketplace in relationship to demand/price has not been deemed determinative. For every product economic substitutes exist. To be included in the same market it is not sufficient that a few customers would shift from one product if its price, relative to the price of another, were raised. On the other hand, it of course is not necessary that products be identical. "Supply substitutability" may not be disregarded. Manufacturers who have existing technological capabilities or tooling to supply reasonably interchangeable products may effectively restrain the power of those in the market to raise prices, but the evaluation of whether this is so, again, is dependent not upon mere theory but upon the reality if any of the effect of the potential in the marketplace. While the potential need not necessarily be an immediate one, it must not be so remote as to have no actual influence on the competitive situation. A relevant market cannot be enlarged by theoretical speculation as to future market conditions or potential substitutability having no substantial effect upon competition during a period in question. I find that neither cross-elasticity or interchangeability of use or demand, nor substitutability of supply, critically militates against the relevant market and submarket definitions within which IBM's market power will now be assessed.

V. MARKET POWER

F56. Monopoly power is the economic ability to charge unreasonably high prices and to exclude competition. Proof of the actual use of such power for these purposes is not essential to a finding of its existence but would be an important factor in any assessment of market power. The strength of competitors is relevant to an assessment of market power. Monopoly power presupposes the power to control what happens in a relevant market. Ease of entry may be an indication of lack of market power on the part of an alleged monopolist. Difficulty in entering, weakness of competing companies and dependence of competitors upon dominant forces in the market are among indicia of market control on the part of an alleged monopolist. Necessity of competitors to react to price changes by the alleged monopolist, particularly above or below a scale based upon self-determined reasonable cost and profit may be important. If the percentage of a relevant market controlled by an alleged monopolist is high an inference of market power may be drawn. Where its control is moderate no inference of market control may be permissible. In case of a medium range, it may be impossible to infer or to rule out monopoly, so that factors other than market percentage must be looked to primarily. Where there is direct credible evidence of market domination or predatory practices which are productive of contol in a particular relevant market, inferences need not be depended upon but this more direct evidence may be determinative.

Other factors to be considered are any necessity on the part of an alleged monopolist to meet competition in technology and pricing, the equality of performance in the industry and its comparative youth, growth and dynamics or change. Claimed necessity of responding to competitive influences beyond the control of the alleged monopolist may be only its excuse for anticompetitive conduct for the purpose of maintaining or extending monopoly power or to surmount threatened competition, and monopoly is possible in a young, dynamic and complex industry as well as in an old or static one, and may be even more feasible in special cases through masking of selective market strategies in the overall technological developments. Sophistication of users or competitors may discourage monopoly but equal or greater sophistication on the part of an alleged monopolist may be a counterbalancing factor, and industry dynamics may continue in evidence through technological momentum beyond the inception of monopoly. While these and other criteria and their limitations have been considered, it is recognized that the question of monopoly control is one of fact to be determined on the whole record and not susceptible of being resolved by any mechanical applications.

F57. By their arguments and proposed findings, plaintiffs would have the court find that in the period 1969 to 1972 IBM possessed monopoly market power in a general systems relevant market as well as in the more limited relevant plug

compatible market and the submarkets for magnetic tape products, direct access storage products, memory products, impact printer products, and communication controllers that are plug compatible with an IBM central processing unit. Little or no evidence was introduced in these cases that IBM evidenced an intent to monopolize, or directed efforts toward monopolization of the EDP systems market in general, except through its more focused conduct. Presumably plaintiffs now do not wish to rest their case entirely upon their plug compatible market theory, or at least consider that the dominant position of IBM in the general market supports, or lends substance, to its claims that IBM monopolized or attempted to monopolize the plug compatible market or submarkets. On the other hand, the position of IBM in the general market lends increased force to its arguments concerning its declining market share, the dynamics of the industry, the strength of competitors, and other factors tending to negate a monopoly position. While it is believed that the position of IBM in the general EDP industry, particularly with reference to general systems, is relevant, the evidence is insufficient for a finding, and it is unnecessary in the court's view to find in order properly to resolve this case, that IBM during the relevant period monopolized or attempted to monopolize the general systems market.

F58. There is no question but that IBM occupied, and continues to occupy, an important position in the systems market. In 1970 revenues reported from electronic data processing products and services according to the census, IBM was the leading company in the industry, with almost $3.5 billion of revenue. AT&T which is not a systems manufacturer was next largest in terms of EDP revenue, $759,135,000. Of the next three largest companies, Univac (Sperry Rand), Honeywell and Control Data, none had EDP revenues in excess of $460 million. Internal IBM documents containing measurements of IBM's share of the domestic market for systems and peripherals place IBM's market share progressively decreasing from 75.9% in December, 1964, to 73.3% in September, 1968, and IBM's market share of central processing units (CPU's) progressively decreasing from 68.6% in 1964, to 64.4% in 1968.

F59. Defining the market broadly, as IBM claims it should be, competitors include many large diversified companies with important skills and substantial financial resources, and many competitors are strong, independent and growing. Entry into such a broad market has not proved difficult for many companies. Between 1952 and 1970 the number of competitors in the EDP industry multiplied more than 136 times, from 13 to 1773, according to the census. The total United States EDP revenue has increased about 212 times from $48 million in 1952 to $10.2 billion in 1970. Many companies, in addition to IBM, have shown spectacular growth, although none to the extent IBM has. The number of companies which manufactured systems increased from 3 in 1952 to 96 in 1972. IBM's technology, and its organization and diligence in advancing it, have been of high quality, contributing in a substantial degree to IBM's general success in the industry. There is little or no indication in the evidence introduced in this case that IBM adopted specific programs to throttle or impede general systems competition or that it sought to implement any predatory intent with respect to the EDP industry as a whole, as distinguished from efforts directed specifically against the marketers of peripheral equipment plug compatible to its CPU's.

F60. Generally speaking, EDP customers have been furnished with progressively better products at progressively lower prices. Memory capacity has increased by a factor of approximately 700 from the Univac I to the IBM 370/168. Performance of the CPU as measured in the execution of additions, multiplications and divisions per second had increased by a factor of over 4300, 3100, and 2000, respectively, from the Univac I to the IBM 370/168. The fourth generation 370/168 costs only a little less than seven times as much as the first generation Univac I. The performance of tape drives as measured by the transfer of characters per second has increased by a factor of 46 from the tape drive used with Univac I to the tape drive used with the 370/168 for an approximately 1⅔ price increase. There has been a 16 fold increase in storage capacity as well. From the first to the fourth generation, there has been a 13 times performance improvement in printers for less than 3 times the price increase. There has been a 37 times performance improvement and a 20% drop in price in disk files from the first to the fourth generation. The requirements of electronic data processing users, and the profusion of companies attempting to fill those needs, have led to a marked increase in the performance of products and significant decrease in the cost per unit of computing. Broadly defined the EDP industry appears competitive and dynamic.

F61. IBM's market share of the EDP industry as a whole or the general systems (CPU) market does not of itself justify an inference of monopoly power in the market as so broadly defined, or at least as to this plaintiffs have not discharged their burden of proof to show monopoly power as a part of their monopoly complaint: According to the census, IBM's 1970 share of reported EDP revenue for hardware and leasing companies over $5 million, 42.3%; its 1970 share of reported EDP revenue for hardware companies over $5 million, 44.9%; its 1970 share of reported EDP product revenue, 44.5%. IBM's share of the value of 1971 shipments of "electronic computers and peripheral equipment, except parts", according to the U.S. Bureau of the Census, was 36.7%. IBM's share of the value of 1971 shipments of "Electronic Computers, Digital, General Purpose", according to the U.S. Bureau of the Census, was 40.9%. IBM's share of the value of 1971 shipments of "direct access storage units such as magnetic tapes and drum, magnetic cord and bulk core memory", according to the U.S. Bureau of the Census, was 30.4%. Its share of the value of 1971 shipments of "serial access auxiliary storage units such as magnetic tape units", according to the U.S. Bureau of the Census, was 45.6%; its share of the value of 1971 shipments of printers, according to the U.S. Bureau of the Census, was 38.3%. These shares have been declining. IBM's share of reported EDP revenue has declined from 64.1% in 1952, to 35.1% in 1970, and there have been comparable declines in others of the categories above-mentioned.

F62. The figures on market share particularly with reference to plug compatible peripherals are not readily available from published sources, nor can they be extrapolated or inferred from census data dealing with peripheral products in general, some of which have been cited above. But the defendant, in the processing of its marketing strategy and planning, developed an organization and system well designed to segregate these data, since its studies were directed specifically to the narrower markets. Accordingly, while the court has considered the general data available, and inferences reasonably to be drawn therefrom, it has seemed fair and appropriate to afford considerable weight to data available from defendant's studies, and it has .

F63. The inception of a related market was natural because of the dominance IBM products commanded in the marketplace and the feasibility of furnishing functional equivalents to some of these products which could be rendered plug compatible with IBM CPU's. The devices marketed by Telex and others plugged into and replaced parts of the System 360 family, and ultimately parts of the 370 family were replaced. Notwithstanding some difficulties of rendering interfaces compatible, and developing the personnel and technology to design and manufacture or otherwise secure equivalent devices, entry was initially easy for peripheral equipment manufacturers because they could choose to copy only proven successful products. Moreover, they could utilize in many instances systems hardware provided by the system manufacturer and typically would sell only after all systems engineering, systems marketing, side preparation and systems installation work had been completed. The number of companies supplying peripheral equipment plug compatible with IBM systems grew from 2 or 3 in 1966 to some 100 today. A number of these handled only one type of device and few if any had the variety of peripheral devices plug compatible to IBM CPU's that Telex had. The relatively large number of companies in time engaged in the plug compatible business did not represent a corresponding dispersal of the business, since the major share during the developing years was concentrated within a matter of a dozen plug compatible manufacturers (PCM).

F64. Of course, with respect to the IBM peripherals later replaced by plug compatible devices of other manufacturers, IBM initially had 100% of the market. But as the plug compatible business developed on the part of other manufacturers or suppliers, IBM's market share was substantially eroded, and in due course it became a concerned competitor for peripheral devices to be attached to its own systems. Starting in 1968 there was a very rapid growth in the quantity of equipment shipped by peripheral equipment manufacturers which was plug compatible with IBM CPU's. This occurred first with tape drives in 1968 and then with disk drives in 1969 and this plug compatible growth continued into and perhaps through 1970, and became in itself an important and recognized market which increasingly was enlisting new participants and inviting plans for further expansion.

F65. The increase in plug compatible business and the decrease in IBM's share of the plug compatible market must be evaluated in light of the foregoing circumstances and the fact that it was not until 1970 that IBM's strategic and tac-

tical responses to the inroads of the plug compatible manufacturers became really effective. The apparent vitality of the plug compatible market and the increase in the number of companies engaging therein accordingly cannot be considered as necessarily negating the monopoly power or predatory intent of IBM, since as far as the evidence discloses IBM did not really begin the exercise of whatever market power it had as against plug compatible equipment manufacturers until the period 1969–1970. It also is relevant to note that any increase in competitive entries into the market in 1972 and 1973 could well have been affected by the institution of the present litigation in early 1972, and, for prospective entrants, at least some possibility which pending litigation to obain remedial action may have held out.

F66. The testimony of Bonham and the Bonham charts indicate in accordance with the census that in 1970 IBM received revenues of $1,137,819,000, from its plug compatible pheripheral products, and all other manufacturers of IBM plug compatible products together received slightly in excess of $100 million in revenues; that in 1970 IBM had 90% of the revenues from tapes attached to IBM CPU's and PCM's had 10% of the revenues; that in 1970 IBM had 68% of revenues received from disk drives attached to IBM CPU's and PCM's had 32%; that in 1970 IBM received 99.6% of all revenues for memory products attached to IBM CPU's and that PCM's had the remaining .4% of memory revenues; that in 1970 IBM received 92.3% of revenues from communication controllers attached to IBM CPU's and that the PCM's had 7.7% of such revenues.

F67. IBM's internal documents indicated that in 1970 IBM had 80% of tapes (units) attached to IBM CPU's, and that PCM's had 13%; that in 1970 IBM had 94% of disk drives (units) attached to IBM CPU's, and that PCM's had 6%; that in 1970–71 IBM had 99% of the market for impact printers attached to IBM CPU's; that Telex was an entrant in the high speed impact plug compatible printer market with a potential market share of 8.5% for PCM's, and 91.5% for IBM by 1978; that Telex and a number of other companies were potential entrants into the plug compatible memory market, and that the total number of units of magnetic tape devices (240X–2420–3420 type) and disk drive products (2311–2314/2319's–3330 type) attached to IBM central processing units as of December, 1970, June, 1971, and December, 1971, June, 1972, and December, 1972 (both the PCM's and IBM's share including all devices marketed by them whether leased or sold) were as follows:

TAPE DRIVES—204-2420-3420 TYPE, TOTALS INSTALLED ON IBM CPU'S

	12/70 units	Percent	6/71 units	Percent	12/71 units	Percent	6/72 units	Percent	12/72 units	Percent
IBM	36,726	89.8	35,742	86.3	36,403	86.0	37,944	86.1	39,670	85.1
PCM	4,169	10.2	5,668	13.7	5,931	14.0	6,116	13.9	6,952	14.9
Total	40,895		41,410		42,334		44,060		46,622	

DISK DRIVES—2311-2314/2319-3330 TYPE, TOTALS INSTALLED ON IBM CPU'S

	12/70 units	Percent	6/71 units	Percent	12/71 units	Percent	6/72 units	Percent	12/72 units	Percent
IBM	65,686	93.2	63,574	85.5	65,941	84.2	66,622	82.7	68,002	82.5
PCM	4,833	6.8	10,748	14.5	12,402	15.8	13,967	17.3	14,445	17.5
Total	70,519		74,322		78,343		80,589		82,447	

F68. The Bonham charts on which some of plaintiffs' contentions with reference to market share are based cannot be taken at face value and must be evaluated with reference to related circumstances as shown by the evidence. For example, only revenues from the principal or dominant PCM's in the market are included in some of the charts; revenues from leasing companies which acquired IBM plug compatible memory devices and disk devices from IBM and marketed them in competition with IBM were excluded and the figures were not updated to indicate a probable continuing decline of certain IBM market shares during the period 1971–72. Weighing these and other factors, and particularly testing the charts as against the internal documents of IBM with reference to its shares of the relevant submarkets, it is fair to say that they

support a finding that IBM's share of the relevant submarkets or the combined submarkets comprehended in the general market classification "peripheral equipment plug compatible to IBM", is such as to permit an inference of monopoly power on the part of IBM, and the court so finds.

F69. IBM's internal documents generated in connection with competitive studies looking toward management decisions to meet the competition of plug compatible manufacturers have been deprecatingly referred to in argument by the defendant as being the products of non-management employees, or as grossly underestimating competition. It seems appropriate to note here, however, and for later reference in connection with the predatory conduct of IBM, that most of the studies were made by highly trained and qualified IBM personnel acting within an organization justly noted for its perception and responsiveness to market conditions, and with technological standards and aids likely superior to most great companies of the United States. There were some uncertainties in the precise sources of some data coming to the attention of management, and some combinations of documents in the evidence did not represent the precise form in which they were submitted to management. Yet the inputs into management with reference to competitive and market situations, the testing and processing by management of these inputs and its rather consistent acceptance of their bases in any management outputs, indicate to me, by and large, in view of all the circumstantial evidence in the case that IBM's internal documents represent significant evidence not only as to market shares but as to the intent and purpose of the defendant. They were prepared for submission to management in the course of the business of a highly competent and effective organization at a time when we can assume that their litiguous significance was not distorting. They were represented by forecasts, chart presentations, tables, and similar documents and were generated with specific reference to the competitive situation involving the plug compatible market at the time, and their relationship to top management decision under all the circumstances may be readily perceived in most critical instances.

F70. On the basis of all of this testimony with reference to market shares, inferences that may be reasonably drawable therefrom, direct testimony as to IBM's domination of the relevant markets and submarkets, and the effect upon competitors in this market and submarkets of its predatory competitive practices, during the period 1969 to 1972, inclusive, I find IBM possessed monopoly market power in the relevant market of peripheral equipment plug compatible to IBM CPU's and in the relevant submarkets for magnetic tape products, direct access storage products, memory products, impact printer products and communication controllers plug compatible with IBM central processing units. The court further finds in this connection that this general market and the submarkets specified above comport to the competitive realities of the period: that by reason of the peculiar development of the EDP industry with the historical domination of IBM in the general systems market, with the market of plug compatible peripherals growing up, in historical and developmental fact, as a separate competitive entity along with its submarkets, the separate reality of this market along with its submarkets cannot be dismissed or ignored as a mere example of a manufacturer necessarily having a monopoly of its own product. The court further finds that whether the submarkets hereinabove defined be considered separately and severally or whether they be combined into the market for peripheral EDP equipment plug compatible with IBM CPU's, monopoly power during all periods material herein was possessed and exercised by the defendant IBM.

VI. IBM'S PRACTICES AND INTENT

F71. IBM's top managemnet became concerned in the summer of 1969 that IBM forecasts with regard to plug compatible competition were understated. This concern was intensified in January of 1970 when IBM learned that the Bureau of the Budget intended to encourage federal agencies to use equivalent lower cost plug compatible products with IBM central processing units instead of IBM peripheral equipment and standard interfaces had been suggested.

F72. By 1970, some plug compatible devices offered in the tape and disk areas by PCM's were, in fact, functionally superior to, and were regarded by IBM as superior to, their corresponding IBM products. The Telex 4700, 4800 and 5420 model tape drives were, in fact, superior and were regarded by IBM as superior products to the IBM equivalent tape drives Models 729, 2401 and 2420. Telex's 5311 and 5314 disk drives were in fact superior, and were regarded by IBM as superior to IBM's equivalent 2311 and 2314 disk drives.

F73. In response to the increasing competition IBM was receiving from plug compatible manufacturers marketing some functionally superior peripheral devices in the tape and disk areas, IBM's Management Committee, in February of 1970, designated peripherals as a "Key Corporate Strategic Issue" (KCSI). To be so designated was a management device to deal with an issue that had broad implications and required the attention of its top corporate management.

F74. After the designation of peripherals as KCSI, a task force was formed in March of 1970 to be headed by H. E. Cooley, Vice President of the Systems Development Division. The Peripheral Task Force or Cooley Task Force, as it became known, met regularly both in formal and informal meetings from the middle of March of 1970 until its report to the Management Committee of IBM on July 31, 1970. The objective of this task force was to examine the competitive threat to IBM of plug compatible suppliers. A Telex trial witness, Richard Whitcomb, who was IBM's manager of I/O Systems Marketing from the fall of 1968 to the summer of 1971, participated in the work of the Peripheral or Cooley Task Force on behalf of the Data Processing Division. A purpose of the Peripheral Task Force was to study and recommend plans and product strategies to impede the growth of IBM's plug compatible competition. The Peripheral Task Force made in-depth analyses of various plans and strategies each having as a significant purpose the containment and retardation of the growth of IBM plug compatible competitors. The task force made in-depth assessments of the status of plug compatible competition and analyzed the viability of particular plug compatible competitors, including Telex.

F75. In the summer of 1970, IBM's top management believed that plug compatible competition was one of IBM's major business problems. And the "Mallard" project was the first concrete response to this problem. The Mallard disk file was announced by IBM as the 2319A disk storage facility for the Model 145 System 370 on September 23, 1970. The 2319A was a reworked 2313 disk drive with one of the spindles removed. IBM removed one of the four disk drives from the 2313 box (IBM's four spindle 2314 type disk drive box) and put in some of the control function electronics from the 2314 controller. The control function on the 2319A for the 145 was handled by integrated file adapter (IFA) that was placed underneath the covers of IBM's System 370/145, together with the portion moved into the disk file cabinet. The user had the option of using the 2314 subsystem attached directly to the channel instead of the internal IFA. The software programming support for the operating system was identical in each configuration.

F76. The 145 end-user who elected to use a 2314 controller, a 2312 and a 2318 for a three spindle configuration, instead of the IFA and 2319A, was charged the higher 2314 prices for the same identical function. In short, if the user did not choose the IFA and 2319 he received no price reduction for the disk drives utilized on the 145. The end-user who selected the IFA/2319 disk drive subsystem for the 145 saved $1,325 per month on a three spindle configuration. The $333 per spindle price represented a $103 per month reduction per spindle below IBM's price per spindle for its 2313 four drive configuration. IBM's monthly rental per spindle for the 2319A was $100 per month lower than Telex's then current price per spindle for Telex's equivalent drive; and, was less than the price then being offered by IBM's plug compatible competitors. The monthly rental adopted by IBM for the 2319A was the lowest rental profile considered by its management prior to the announcement. The price level announced was forecast by IBM to have maximum impact on IBM's plug compatible competitors. Prior to the 145 announcement, IBM considered raising the rental price of the 145 CPU to offset the revenue reduction that would result from the reduction associated with the IFA/2319 when compared to the 2314 control unit with the 2312/2318 attached.

F77. The 2319A disk subsystem did not substantially increase the performance of the 2314 subsystem. The end-user customer received similar functional performance by utilizing a three spindle 2319 box with the IFA as he did by utilizing a 2314 subsystem. The data rate, the access rate, and the data capacity per spindle were the same. IBM's price cuts for the 2319A and IFA were not justified upon the basis of reduced manufacturing costs.

F78. IBM may have reduced its cost somewhat through reuse of 2314's which were being returned to IBM because of plug compatible competition, but it is clear from the evidence that any decreased cost was of minor importance or influence in the Mallard plan and that price reduction independent of cost on limited products in competition with plug compatible suppliers was the primary purpose of the response. IBM camouflaged the 2319A price cut as a "new" product for the

purpose of avoiding a general price reduction to all its installed 2314 subsystems which would have reduced IBM's revenue stream of $514 million a year on its installed disk base by approximately $120 million per year.

F79. The 2319A price cut was designed by IBM specifically to contain plug compatible competition. It originated in the Cooley or Peripheral Task Force and was approved by top management. Its primary purpose was to maintain control of the plug compatible disk market for IBM. It was introduced by IBM with the specific purpose and intent of suppressing plug compatible disk competition. IBM admits, indeed argues, that its action was a competitive response necessitated b ythe inroads of plug compatible competition and that it in fact did not succeed in maintaining IBM's market share. But IBM already possessed a dominant market share, and continues to do so. Notwithstanding lawful acquisition theretofore, its intent to maintain its monopoly by unlawful predatory conduct cannot be equated reasonably with an ordinary competitive response.

F80. IBM, in October, 1970, organized a second peripheral task force to analyze plug compatible competitors in the disk drive area. The scope of the task force study included analyzing of the marketing, management, maintenance, production and engineering capability of IBM's plug compatible competitors. The group was directed to study and estimate the announcement and first customer shipment dates on PCM's 3330 equivalents and make a cash flow analysis, including financing arrangements, of PCM's, to make an estimate of the PCM's 2314 manufacturing cost and to determine "how long can OEM PC suppliers go on 2314 prices" This group's report concerning Telex concluded that Telex was viable, that its management was competent and aggressive and that it had a strategy of marketing a full line of high volume IBM plug compatible peripherals, that its in-house engineering capability was good, but that its manufacturing costs were 10% to 15% above IBM's. The Telex analysis concluded that Telex's cash flow was inadequate to permit Telex to finance its own lease base and that Telex's key exposure was "impact by IBM—shortens product life."

F81. Prior to a further announcement involving the 2319 IBM had concluded that Memorex and Telex were the two most significant plug compatible competitors for 2314 type disk drives. Telex witness Whitcomb in his role as IBM's I/O Marketing Manager attended a presentation by Telex's deposition witness, Fassig, on Memorex and Telex in the fall of 1970. Fassig's presentation was an analysis of the impact on Memorex and Telex of various price cuts by IBM on 2314 drives, the corresponding price reactions that Memorex and Telex would be forced to make, and the effect upon their viability. Fassig's analysis demonstrated that as IBM would cut the price in the 2314 area, and Memorex and Telex would respond, there would be a very serious impact on the profits and revenues of both Memorex and Telex. By October 20, 1970, IBM's Management Review Committee was considering extending the 2319 program to the System 360 and the elimination of IBM's extra use charge on disk drives. On December 10, 1970, the Management Review Committee approved the "2419B" announcement.

F82. IBM announced the 2319B on December 14, 1970. The 2319B was a single box containing three 2314 disk drives. The 2319 did not attach to an IFA but attached to IBM's 2314 control unit. In conjunction with the 2314 control unit the 2319 could be utilized on all IBM Systems 360 and 370 computers to form a disk subsystem of three, six or nine 2314 drives (8 drives plus a spare). The 2319A announcement only permitted the use of one 2319A box with the IFA. The 2319B announcement permitted the use of an additional 2319B box with the 2319A box and the IFA, thus giving the 145 IFA user the option of using the IFA and two 2319 boxes with an additional 2314 box to make up eight drives, or using the 2314/2319B nine drive subsystem.

F83. IBM's rental price on the 2314 control unit utilized with the 2319B remained at $1,480 per month. IBM's rental price on the 2319B was set as $1,000 per month, or $333 per 2314 drive—the same price that had been set by IBM on the 2319A announcement. The monthly rental price on the 2319B represented a substantial price cut for 2314 drives. In a 2319 subsystem consisting of three disk storage units, the 2319 monthly rental price represented a price cut of over $1,000 per month for a 2314 subsystem. In addition, the 2319B announcement eliminated IBM's extra use charge on 2319A, 2319B and 3330 disk drives. The elimination of the extra use charge represented an additional and substantial price reduction. The 2319B announcement was purely a price cut. The 2319 did not even purport to represent any increase in performance in a 2314 subsystem. This price cut was to a point below the prices IBM's plug compatible competitors were charging for their plug compatible equivalent 2314 drives.

IBM's price cut on the 2319B announcement cut the price of the nine 2314 drives used in a 2314/2319 subsystem approximately $700 below the average price of IBM's plug compatible competition and $800 below Telex's price.

F84. Just after IBM made its 2319B announcement IBM had an installed base of 47,051 lease and purchase 2314 spindles, as compared to an installed base of 2,639 2314 equivalent type spindles for all of its plug compatible competition together, and further, IBM had over 94% of all disk drives installed with IBM CPU's. IBM forecasts and analyses with respect to the adoption of the 2319B program considered IBM's competition with plug compatible manufacturers. None of the IBM forecasts and analyses with regard to the adoption of the 2319B program was expressed or geared in any way toward competition between IBM and systems manufacturers, leasing companies, software and consulting organizations or service organizations. The 2319B was designed by IBM as a predatory action contrived to maintain its 94% control of the plug compatible disk market.

F85. IBM's 2319B price cut substantially impacted its plug compatible competitors' revenues and profits by reason of responsive price reductions which IBM had anticipated would have to result, but it did not succeed in fully protecting IBM's installed base. As Mr. Evans, then President of IBM's Systems Development Division, testified: "For a month or two after the 2319 was announced, the plug compatible sales leveled off; but then, as I recall, there were pricing actions by the competition, and that curve turned right back upward." Not only did IBM plug compatible competitors lower their prices but the plug compatible competitors had complete modularity (1 drive per box) on their 2314 equivalent drives and by reducing their price per drive they were able to sell between the configurations of IBM's three, six and nine 2319 drive subsystem configuration. (1, 2, 4, 5, 7 and 8 drive configurations.) Mr. Finnell reported to the Management Review Committee in January, 1971, with regard to IBM's 2319B and 3420 pricing actions: "OEM reaction to our recent tape and disk pricing action . . . were as expected or lower. We are continuing to update our 1971 forecasts—raises the question of are you really ahead or are you back to where you started before you adjusted your own prices."

F86. In December, 1970, IBM announced a price reduction for all its disk devices, including the 2314, 2319 and 3330, by eliminating all additional use charges. Immediately after IBM's announcement of the 2319B, Telex negotiated the 28% price reduction from its supplier ISS for the 2314-type devices it was buying. Telex, other peripheral equipment manufacturers, and some leasing companies dropped their prices for the 2314-type devices to levels substantially under those of IBM. After the decrease in Telex disk device prices the order rate of Telex disk devices again increased significantly. In the period from November, 1970, to December 31, 1972, Telex shipped 1074 more 2314-type disk drives and 191 more 2314-type disk controllers than it had forecasted in Novmber 1970, that it would ship.

F87. Telex claims that as a follow-up predatory action IBM announced its 3420 or "Aspen" tape device; that Aspen was not planned by IBM until after PCM's started gaining substantial shares of the installed base from magnetic tape products, and that Aspen was a price manipulation which was conceived to reduce the number of drives marketed by plug compatible manufacturers without reducing IBM's revenues from its installed 2420 tape drives. While there is some evidence to support such a theory, the court considers it less than preponderant and finds that the announcement and marketing of Aspen was not predatory and did not represent in and of itself an unlawful attempt to monopolize. The Aspen devlopment began in approximately 1966, and finally incorporated significant technological innovations not found in prior tape devices. The price of the IBM Aspen was based on lower cost when compared to the 2420 and included reasonable profit. Telex announced its equivalent 2420 products almost two years after the announcement of the 2420 Model 5 and has offered insufficient proof as to how in any event it was damaged by the 2420 Model 5. There was no Aspen issue included in the final pre-trial order, but the court has made the foregoing findings against the possibility that it may be contended that such an issue with the acquiescence of the parties was actually tried and considered during the trial.

F88. Telex contends that IBM's announcement of its Fixed Term (leasing) Plan (FTP) in Many of 1971 was a predatory act and that similarly IBM's announcement of its Extended Term Plan (ETP) in March of 1972 was a predatory act. Telex also claims that FTP and ETP constituted illegal restraints of trade because they locked out competitors; and a further contention is made that

IBM's announcement of a CPU price increase of July 28, 1971, was undertaken specifically for the purpose of recouping the losses occasioned by the introduction of FTP. IBM denies these contentions and alleges that it announced its leasing plans in response to similar plans offered by virtually all IBM's competitors, recognizing that without some form of long term lease it would suffer serious and continuing loss of business to systems manufacturers, leasing companies and peripheral equipment manufacturers, pointing out that it now has three long term lease plans under which it offers most of its EDP equipment. Again, there seems little question but that in a different context, or directed to general competition, the leasing plans adopted by IBM might be unexceptional or entirely justified. The question remains, however, whether in the setting of IBM's dominant position in the plug compatible submarkets and in view of the evidence as to its specifically directed intent and concern with reference to the plug compatible competition in those markets, the two leasing plans above-mentioned can be sustained as against Telex's attack.

F89. IBM's 2319B announcement failed to retain IBM's high share of the plug compatible disk market and failed to contain the growth of IBM's plug compatible competition during the first quarter of 1971. The latter continued to make strong advances with its installations in the 2314 disk area. By February 12 IBM's plug compatible competitors had installed 3,006 2314 equivalent spindles; by March 15, 3,491; and by April 9, 4,614. IBM's plug to plug peripheral competition commenced to proliferate from tapes and disks to printers in the last quarter of 1970. By September, 1970, IBM anticipated that Telex would have a plug to plug compatible printer, and revised its printer forecast. Telex was regarded by IBM as the leading competitor in the plug compatible peripheral marketing area because of its broader product lines, having tapes, disks and printer, and IBM suspected that Telex would soon offer a memory device.

F90. Mr. Whitcomb prepared an overview study of IBM's plug compatible competition late in the first quarter of 1971. This overview study was presented to the President of IBM, IBM's Data Processing Division, and IBM's Management Review Committee. It concluded (a) the plug compatible phenomenom was accelerating in volume and scope; (b) the plug compatible competition presented a serious threat to IBM's potential growth since the exposed peripherals represented 63% of IBM's installed lease base; (c) defending against plug compatible competition was difficult because of their pricing and performance advantages; (d) IBM should try to combat peripheral competition by frequent advances in technology utilizing "mid-life kickers" and pricing which would take advantage of IBM's short-lived product lead in the peripheral area including the consideration of long term uses; 13% of IBM's systems were "contaminated" with plug compatible tape or disk equipment and PCM penetration would increase with package selling. Specifically, the Whitcomb study found that IBM would lose 19% of the plug compatible tape market by 1976 and IBM's planned tape program was inadequate and IBM would lose 28.7% of the plug compatible disk market by 1976 and IBM's planned disk program was inadequate.

The Whitcomb study also found that IBM should be concerned about the memory and printer areas. While it is clear that IBM expected plug compatible competition to increase in volume and scope by the end of the first quarter 1971, it is also clear that IBM, even by its worst case forecast only anticipated loss in the neighborhood of 20 to 25% of tape and disk markets to all of its compatible competition by 1976.

F91. Even after the 2319 price cuts, IBM on in-depth study considered Telex a "viable" competitor that could "manage impressive earnings. . . ." In April, 1971, IBM's Management Review Committee concluded that its control of plug compatible disk and tape drives was being eroded and the printers and memories would be next. IBM determined to deal more effectively with its plug compatible competition. At a Management Review Committee meeting on April 23, 1971, IBM's chief executive officer, Mr. T. J. Watson, Jr., formulated IBM's basic policy approach. Mr. Watson informed the Data Processing Group that he wanted "a clear understanding that the company swallow whatever financial pills required now and get ready for the future . . . irrespective of financial considerations of one of two years—must return this business to a growth posture and operate accordingly." Mr. Watson stressed the need for IBM "to make the hard decisions today so that the same problems don't have to be faced again and again down the road." IBM's Management Review Committee appointed a task force to develop a new peripheral strategy and specific action programs to deal with plug compatible competition. The task force, although not specifically

given that name, was sometimes known within IBM's organization as the "Blue Ribbon Task Force".

F92. On May 6, 1971, this task force made a report to IBM's Management Review Committee (MRC). It recommended drastic tape and disk price cuts to contain IBM's plug compatible competition. Specifically, the task force recommended that IBM reduce its price by 50% on 2314 and 2420 disk and tape drives, by 20% on 3330 disk drives and by 15% on 3420 tape drives. The MRC rejected these recommendations and directed the task force to develop a strategy for memories and printers and to rework "the possibility of a long-term leasing approach as suggested by FTC (Frank T. Cary)." In the ensuing three weeks this task force made a number of reports to IBM's Management Review Committee on long-term leasing of specific peripheral products. The MRC gave final approval to IBM's Term Plan (FTP) on May 25, 1971.

F93. The task force's presentations and recommendations to IBM's MRC during May of 1971, indicated that some disks, tape and printers were going to be included and some omitted from FTP, and that there would be an omission of card I/O devices and system 3 products. Most of its iterative forecasts were in terms of the impact that IBM action would have on IBM's plug compatible competition. The inclusion of the 1403 N1 and 3411 printers was recommended because of plug compatible competition expected from Telex. The task force determined that the Fixed Term Plan leasing would cost IBM millions of dollars in revenues and profits during the first two years, and projecting that on disk drives IBM would lose $13,200,000 in 1971, and $20,300,000 in 1972; on tape drives $6,500,000 in 1971 and $5,300,000 in 1972; on printers $11,800,000 in 1971, and $18,500,000 in 1972. In short, the task force determined that IBM would sustain revenues reduction of more than $75 million in 1971 and 1972 by putting tape disks and printers under FTP leases. Notwithstanding these projected loses, it was thought that FTP would be very profitable to IBM in the long run because losses from plug compatible competition would be decreased and it would have more units out in the field for longer periods of time.

F94. On May 27, 1971, IBM announced FTP. One and two year leases on IBM disk, tape and printer peripheral products (except those excluded) were provided for, with an 8% monthly rental discount for one-year leases and a 16% monthly rental discount for two-year leases. IBM also eliminated its extra use chargs on products leased under such leases. Punitive penalties for cancellation of a lease by a customer were included. The penalty for a two year lease terminated during the first twelve months was five times the monthly rental charge. The penalty for a one year lease cancellation, or a cancellation of a two year lease during the second year, was two and one-half times the monthly rental charges on disk products covered by the two year Plan by 31%, and its covered.

F95. IBM's price cuts under the Fixed Term Plan were even greater than the apparent 8% to 16%. The elimination of IBM's extra use reduced IBM's monthly rental charges on disk products covered by the two year Plan by 31%, and its tape products by 20%. On printers the reduction was about 30–35%. The price cuts in many instances put IBM prices below those of its plug compatible competitors.

F96. The benefiits anticipated by IBM in connection with the adoption of FTP revolved around the suppression of IBM's plug compatible competition. Indeed, the very creation of the task force was occasioned by plug compatible competition. Pricing presentations of the task force to the Management Review Committee were importantly concerned with comparisons of plug compatible prices and projections.

Defendant's officers at the trial expressed the view that FTP was simply to render the company "more competitive" and to obtain more business by meeting the competitive efforts on a basis similar to that of plug compatible suppliers. It is the court's view that such justification, which could be convincing under different circumstances, is overpowered by IBM's monopoly position in the particular markets involved and the rather clear indication that its action was directed not at competition in an appropriate competitive sense but at competitors and their viability as such.

The products specified by FTP were those peripheral products on which IBM was receiving, or on which it anticipated that it would receive, substantial plug compatible competition. The statement at the trial by Mr. Carey, Chairman of the Board, President and Chief Executive Officer of IBM, that tapes and disks were covered because "we, obviously, had to reduce our prices on them or go out of business and so they were very logical candidates for the Fixed

Term Lease Plan", aside from its character of confession and only attempted avoidance, was overstated factually.

IBM's plug compatible competition in the disk tape area did not threaten to drive IBM out of the business in those markets. In June of 1971, IBM's plug compatible competitors had only 14.5% of the plug compatible disk market and 13.7% of the plug compatible tape market, and IBM's worst case forecast, that is, "if IBM did nothing", predicted that IBM's plug compatible disk market and 19% of the plug compatible tape market by 1976.

Nor is Mr. Careys' explanation that FTP was merely an experiment borne out fully by the record; it was directed specifically at markets in which plug compatible competition was of special concern to IBM and the selection of these areas was not on the basis of a random experiment to ascertain the effect of the plan, but to accomplish results with respect to these markets forecast in advance by its experts. The plan was extended beyond disks and tapes to printers from an apparent desire to lock up that market before Telex could start deliveries. On May 6, 1971, the Management Review Committee directed the task force to prepare a long term lease approach for disks and tapes "plus a strategy for memories and printers". Telex was known also to be interested in memories.

F97. IBM did not place its CPU's under the Fixed Term Plan. In fact, IBM raised its prices on its CPU's and 350 memories to offset its peripheral price cut within two months after reducing its prices on its disk, tape and printer products under the FTP. Long term leasing represented a substantial change in IBM policy not only in the swing from short or open-ended leases, but in previously contemplated general pricing policy. Mr. Emery, a member of the task force wrote: "It was pointed out in most instances that any policy change which we now advocate for peripherals would have to be applicable to processors as there is no justification for different treatment." One of the studies had concluded that long term lease plans "must apply across the board—peripherals not different". IBM's Management Review Committee at one point instructed the Cooley Task Force not to consider long term lease plans "since there does not appear to be a way of limiting such a plan specifically to the peripheral marketplace".

F98. By January, 1971, IBM had determined that it needed a price increase on products not covered by FTP. The Management Review Committee was actively considering raising IBM's prices in March, and on March 30, 1971, the Data Processing Group made a recommendation to IBM's Management Review Committee for a price increase on CPU's. On April 7, 1971, Mr. Learson wrote Mr. Bietzel stating: "We believe at the moment that we should postpone any pricing action for another month . . ." In late June, IBM rejected the idea of placing CPU's and memories under a Fixed Term Plan on the ground "this would prematurely erode the FTP concept to the entire product line, and, in addition, would be ineffective unless accompanied by some degree of pricing action." IBM not only increased its prices on CPU's and memories in July, 1971, but it was IBM's estimate that those price increases would offset IBM's price decreases on disk, tape and printer products placed under the Fixed Term Plan. On August 5, 1971, Mr. Powell of IBM wrote: "I can support the position that the net effects of the FTP and price change will probably be a wash insofar as business volumes are concerned . . . The net effect of the FTP and price changes will not significantly increase [the customers'] total cost and no system decreases were forecast."

F99. In March 1972, IBM announced its "Extended Term Plan" (ETP), a variation of the Fixed Term Plan having no substantially separate or different economic impact of consequence in this case. ETP also was optional, IBM customers having the opportunity to rent IBM equipment under the 30 day lease contract formerly utilized by IBM if they were willing to forego the price reductions provided in FTP. The defendant has now three long term lease plans pursuant to which it leases central processing units, tape drives and tape drive controllers, disk drives and disk drive controllers, printers, communications controllers, consoles, channels, and other products. In March of 1973, IBM announced a term lease plan which offers a four year lease on System 370 virtual storage processors.

F100. Surface justification for IBM's turning to fixed term plans does not insulate its conduct in monopoly context from serious question. Since the mid-1950's IBM and others have offered their customers the opportunity either to purchase computers or to lease them on short term leases basically cancelable on 30 days' notice. Until the early 1960's many customers were hesistant about making commitments longer than for a month or so at a time because of the

difficulty of evaluating the rapid changes in EDP technology, which situation changed with increasing sophistication of customers and more general acquaintanceship with industrial developments and prospects. For a number of years prior to IBM's announcement of the Fixed Term Plan in 1971, many of its competitors had offered lower prices on long term leases.

By 1971, most of IBM's competitors, including systems and peripheral competitors and leasing companies, were offering users long term lease options. IBM's studies indicated that a long term lease plan on perpipheral products, among other things, would reduce IBM's costs through decrease in "churning" of IBM's leased equipment at the same time and for similar reasons that its competitive position in relation to PCM's would be enhanced. But preponderant evidence demonstrates that IBM's fixed term plan was generated and implemented at the time it was with the primary intent and purpose of suppressing plug compatible competition and to maintain its monopoly power in the plug compatible disk, tape and printer markets and the general plug compatible market for peripheral devices.

F101. With reference to the FTP, as in the instance of the 2319 and memories, the intent and purpose of IBM in taking competitive action or reaction becomes important in view of its dominant position in the markets. Some of the evidence is equivocal. One of the difficulties lies in the inadequacy of the minutes of The Management Review Committee to clearly indicate the reasons for approving the actions complained of here. There was an abundance, or perhaps IBM would now think an overabundance, of documentation in lower echelon views, studies, computations, projections, forecasts and recommendations leading up to the action of the Management Review Committee, the top executive authority in IBM.

In retrospect, and in view of the absence of full documentation at the top, inferences are arguable and have been argued to the effect that the predatory intent clearly indicated by task force or other processors of problems, and their related data, were disregarded or rejected by top management. But I have felt constrained to reject this bland construction by consideration of the record as a whole, and by the very organizational framework within which the record demonstrates such decisions and intents were initiated, formulated and pursued. In the first place I am doubtful that the intent of subordinate agents must be entirely disregarded in determining intent of a corporation represented, as all corporations are, by top management.

Especially is this so in the case of IBM, which the evidence makes clear was finely tuned, organized and managed to reflect to top management the composite of a sophisticated, widespread ad coordinated employee organization for the purpose of management decisions. In the absence of some clear record or indication to the contrary, it reasonably may be inferred that top management in adopting recommended actions or modifications not inconsistent with the data and recommendations submitted did not entirely reject their rationale and reasoning. Moreover, there is considerable direct evidence on vital points to indicate that top management itself did in fact subscribe to the anticompetitive views and objectives of lower echelons, the numerosity and pervasive nature of which preclude their disregard.

F102. One of many examples of the relationship of corporate investigation and processing to corporate decision, the comprehensive and systematic studies constituting input into top management, and the likely dependability of those studies, is furnished by plaintiffs' Exhibit 107R, somewhat randomly selected.

This exhibit is headed "Key Corporate Strategic Issue . . . Peripherals". The objectives were listed as "A. To assess all pertinent factors affecting current and future impact of competitive compatible products on IBM's worldwide business. B. To review current IBM strategies, policies and practices and to identify and prioritize exposure areas in relation to A above. C. To recommend actions required to produce an optimum IBM strategy for peripheral products." After listing "External Factors" such as itemized "Federal Government Environment and Influence", "Marketing Environment", "Maintenance Environment", "Manufacturing Environment", "Pricing Evironment", "Engineering Environment", and "Market Potential and Trends", and after listing "Internal Factors" including "Ease of Competitive Interface" and "Legal Considerations", the "Scope of Issue" is defined.

"The scope of this issue", says the memorandum, "shall be selected competitive compatible products which replace IBM products in an IBM computer system." To obviate any uncertainty, "Competitive compatible products" are further defined as "system attached input/output and memory products." In further refinement it is stated that "Input/output products shall include . . . magnetic tape

drives and control units, direct access storage products and control units, impact printers and control units, card readers, card punches, reader/punches and control units." "Memory products shall include main (buss connected) and large capacity storage (plug connected)". "Excluded products" were "Central Processing Units (CPU)-consoles-paper tape products-communication products and control units-R.P.Q.'s and non standard products-non system attached products."

A comprehensive methodology utilizing line and staff resources, calling for "action program(s) for each pertinent factor", and for the presentation of "program recommendations to MC" (Management Committee). Specific assignments were then made to various staffs, including "Marketing" and "Legal", with an indication that additional line organization was "to be designated by DP Group and WTC." Each assessment was to include, *inter alia*, "IBM Strategy/Policies/Practices Relating to this Factor", "Identification and Priority of Major Exposure Areas" and "Recommendations for IBM Actions."

F103. IBM's Fixed Term Plan effectively suppressed the growth of plug compatible competition in the plug compatible disk, tape and printer markets and effectively contained IBM's competition in the plug compatible market for peripheral devices. IBM's plug compatible competitors' share of the plug compatible disk market never exceeded 17.5% after June, 1971. IBM's plug compatible competitors' share of the plug compatible tape market never exceeded 15% after June, 1971.

Immediately upon the announcement of IBM's Fixed Term Plan IBM instituted an in-depth tracking procedure to determine the effectiveness of IBM's Fixed Term Plan. On June 18, Mr. Rodgers reported to Mr. Learson that IBM had already signed up 16% of its entire installed disk, tape and printer base on the Fixed Term Plan. On June 24, Mr. Justice reported to Mr. Hume that Fixed Term Plans then covered 19% of IBM's installed base on disks, tapes and printers and by July 22, 1971, 40% of IBM's disk, tape and printer installed base was covered by FTP. Mr. Learson wrote, "They are reporting a 40% coverage on FTP. Is this high or low with reference to what we expect. I consider this very important." And the answer came back, "Our objective was to hit 40% coverage on files, tapes and printers combined by 12/31/71."

F104. IBM's plug compatible competitors as expected by IBM made competitive price reactions to the Fixed Term Plan. By June 17, Telex became the fourth plug compatible competitor to announce a price reduction; but even with such price reductions the plug compatible competitors could not successfully compete with the Fixed Term Plan.

Mr. Rodgers estimated that the Fixed Term Plan cut IBM's plug compatible competitors' order rate by 50%. IBM's tracking showed that 90% of its new disk and tape products, specifically its Merlin and Aspen products, were being installed under FTP. This tracking was in accordance with IBM's estimate made in June, 1971, that on the Merlin FTP acceptance would be 95% of the rental base and; in fact, IBM's acceptances have been at the 95% level anticipated by IBM.

IBM in its internal documents described the competitive constraints that its FTP imposed upon plug compatible competition, particularly plug compatible competition for the new 3330 disk and 3420 tape products: "One competitor has already announced a PC 3330/3830 and others can be expected to follow soon . . . The competitor will offer long term leases similar to IBM's with the base rental initially 10% below ours and declining 5% per year. The competitor will face a new environment, however, in that the bulk of his early installations will represent conversions from PC or IBM 2314's rather than plug for plug replacements of installed 3330's.

This will be due to the user's reluctance to break the IBM contract due to the penalty payment required. As a result, the competitor will face harder selling and harder installation since he has not yet shown the capability to provide systems, conversion, and application support . . . While the PC competitors will make a strong effort, it is assumed that near-term 3330 erosion will be contained until the FTP contracts approach maturity. By that time, Winchester, Iceberg, the 3330A/B and the 333M will all be available as customer options and should hold the market for IBM . . . The 3330/3830 FTP will receive wide acceptance in the marketplace. It is estimated that 95% of the rental base during 1971 and 1972 will be under FTP . . . It is further assumed that the savings engendered by the FTP will increase the migration rate from the IBM and PC 2314-type products into the 3330/3830."

F105. By the end of 1971 the effect of FTP on plug compatible competitors was measured by IBM. DP Commercial analysis reported in December, 1971, "Since the announcement of FTP, there has been a 62% decrease in PCM tape monthly sale rate." In disk drives Commercial Analysis reported, "In 4.5 months since IBM's FTP announcement, the PCM monthly sales rate is down to 475 spindles per month, off 48% compared to 905 per month during the first 5 months of 1971."

F106. The plaintiffs claim that the internal Integrated File Adapter for 3330 disk drives used with the 370/135 coupled with a price substantially less than the external 3830 Mod. 2 equivalent, constituted a discriminatory physical and economic tie between the IFA and the 370/135 central processing unit; and that the internal ISC with the rental price substantially less than the external stand-alone equivalent constituted a discriminatory physical and economic tie of the ISC to the 370/145, 158 and 168 central processing units.

These integrated controllers consist of control electronics contained within the same boxes or frames as the CPU's or other EDP equipment and using a part of the CPU resources to perform their functions. IBM offered customers the option of acquiring integrated controllers at prices lower than stand alone controllers and there is no question that prices were substantially lower for the integration.

Unlike the situation which existed in respect to the Merlin, the fixed plan leases and IBM's actions directed to memories hereinafter considered, the integrations mentioned are not shown to have been dictated by specific predatory objectives on the part of IBM. While some question is raised in the evidence as to the economic justification for the extent of the price reductions, and some justifiable suspicion may exist as to predatory intent, a finding that such intent was a significant motivation for the integration is not deemed warranted by the evidence in view of the preponderant showing that these integrations represented a legitimate technological and performance advance consistent with trends in the industry and at significant decreased cost

F107. While cost and performance justifications may have existed to an extent, it is found that IBM lowered the price of its FET monolithic memory products and raised prices on its CPU with the primary purpose of creating barriers to entry for potential plug compatible memory competitors. The 370/155 and 165 were introduced in June, 1970, with magnetic core memories which were contained in boxes external to the CPU, but which were cable-connected to the CPU.

The main memory for the 155 and 165 consisted of the 3360 processor storage together with a high speed monolithic (bipolar technology) buffer storage which made up a two level "hierarchical" type memory. IBM was greatly concerned with the high market penetration which independent manufacturers of plug compatible memories for System 370 threatened, it being estimated by it that such penetration might amount by 1976 to as much as 23%.

Pending the availability of improved technology, IBM's Management Review Committee explored and adopted a memory strategy which repriced memory by reducing prices and by at least partly offsetting this reduction by an increase in CPU prices. Its studies indicated that plug compatible memory companies could become viable competitors in supplying memory for IBM CPU's by offering their products at $6,000 per megabyte if that price was under IBM's prices; that is, viability and entry would depend upon the slope or pricing level of IBM's FET monolithic memories.

F108. IBM formed another task force in March, 1971, which was charged with the mission of developing a "memory strategy" which would optimize profit and revenue for IBM and also control the market penetration that was forecasted for plug compatible memory products. The work of this memory task force included an attempt to fix a price for IBM's monolithic FET memories that would influence potential plug compatible competitors to stay out of the market.

The IBM Management Review Committee set the monthly rental price for IBM's FET monolithic memory at $5,200 per month per megabyte, which was less than the amount reporting experts had indicated a potential competitor would be required to charge in order to enter the market and be profitable and viable. The monthly rental price for the 158 CPU was raised from the $20,600 charged for a 155 CPU to $30,700 for the 158 CPU to offset the decrease in price for the FET memory, the percentage increase in price being higher than the percentage improvement in performance.

The monthly rental price for the 168 CPU was raised from the $36,400 charged for a 165 CPU to $48,600 charged for a 168 CPU to offset the decrease in price for the FET memory, the percentage increase of the 168 CPU when compared to the 165 being higher than the percentage improvement in performance. Neither the design of the 370/158 and 370/168 nor the price of $5,200 per megabyte per month prevented Telex from planning competing memory products and in March, 1973, it announced that it would market memory components for 158 and 168 systems. Control Data, Itel, Ampex and Intel have announced memories for IBM's 370/158 and 370/168 systems at prices substantially below IBM's price.

F109. The same task force studied a proposal that "concurrent with the introduction of FET memories, the minimum entry sizes of the 145, 155, 165 and 195 be raised." A chart considered by it showed that a "minimum" memory of one-fourth megabyte on the 145 would "protect" 71% of the 145 memory from exposure to competition, a "minimum" memory of one-half megabyte on the 155 would "protect" 42% of the 155 memory; and, a "minimum" memory of one megabyte on the 165 would "protect" 37% of the 165 memory from competition. Plug compatible memory vendors were forecast to receive a $35 million share of the market for memories on System 360, $623 million share for memories on System 370 if IBM did not take preventive action.

One of the financial analysts, Hochfeld, in March, 1971, raised the question with his superiors of the legality of increasing memory minimums and the danger of a civil damage suit. He testified at the trial that based upon the studies and analysis that he had done it was his opinion that when IBM dropped its price of FET monolithic memories for the 158 and 168 to $5,200 per megabyte it made it impossible for anybody to enter the field and be viable competing with IBM on the 158 and 168 memories.

F110. Beyond the matter of pricing, plaintiffs contend that IBM ". . . unlawfully bundled" a minimum FET monolithic memory "under the covers" with its 370 CPU's so as to protect a substantial portion of the memory from exposure to plug compatible competition. There is further indication of an anticompetitive design in the investigation of proposals for minimum memories in IBM CPU's, but, again, it appears that there are so many practical and technical justifications for the integration of memory as to raise substantial question concerning the validity of plaintiffs' contention on this point.

Memory is an essential component of the central processing unit since all processing units must have storage to operate. The integration of memory generally tends to reduce cost and improve performance. If memory is packaged separately in a separate box it does require additional frames and covers; it requires its own separate cooling system, power supply, acoustic baffles and electrostatic shielding. It also requires extra cables.

The speeds and circuits used in CPU's have increased dramatically in recent years; to best take advantage of this faster technology it seems desirable, all other things being equal, that memory be integrated into the CPU's so that the wire lengths between logic and memory elements be reduced as much as feasible. As a result of cost and performance advantages integration is accepted as an industry standard and an objective of good engineering design.

Historically most CPU's designed by IBM and various other EDP suppliers have included a minimum main memory integrated within the CPU. Historically also, whenever a main memory has been integrated within a product it has been included in the price of that product and not separately priced. Reduction in the size of memory components has made it practical to integrate more memory with the logic elements of the CPU.

111. The preponderance of the evidence establishes in the case of IBM's 370/158 and 370/168 CPU's that IBM's integration plan was adapted primarily to achieve the cost and performance improvements made possible by reduction in size of the memory component. Other companies are still able to attach their memories to IBM 370/168 and 370/158 Systems and Telex has recently announced its intention to do so.

The IBM 370/155 and 370/165 primarily use magnetic cores for memory, and because of its size such magnetic core memory is sold in a separate box. At the time the 370/155 and 370/165 were announced, advances in semiconductor technology were rapidly obsoleting core memory technology. The main memories of the IBM 370/158 and 370/168 CPU's announced by IBM on August 2, 1972, are made up of FET semi-conductor circuitry. The trend toward miniaturization of computer circuitry no doubt will continue in the future to permit further integration.

Telex itself anticipates that memory chips containing 8,000 circuits will be commercially available by the time it delivers its replacement memories for 370/158 and 370/168 Systems. Using an 8,000 circuit chip, 4 megabytes of storage can be housed in a space approximately 21 inches by 15 inches by 6 inches. Chips containing 64,000 circuits are presently under development at a number of laboratories.

IBM anticipates chips containing 256,000 bits by the 1980's. In the court's view it would not be a proper application of the antitrust laws under the circumstances shown by the record to preclude or discourage the utilization of advancing technology by this type of integration.

The testimony, and particularly Hochfeld's, affords some indication that one of the motivations for the "bundling" of the minimum memory by IBM was to reduce exposure to plug compatible competition. Yet, dominant justifications on other grounds lead the court to believe that this was not unlawful in and of itself, however significant some of the related testimony may be in indication of a predatory intent primarily directed in actuality to other areas as herein found.

F112. IBM's growth and success in the industry have been due in substantial measure to its skill, industry and foresight. It has tended to set the standard for quality in the EDP industry for products and services. It has met notably favorable response in the market, and has been deeply involved in the phenomenal growth of the industry since almost its beginning. Each succeeding generation of IBM products has represented some technological improvement over the preceding generation and has involved development of new processes, storage devices, input/output devices and software.

In the approximately twenty years that the EDP industry has been in existence IBM has introduced more than 600 products. Some of these products include major technological innovations. By virtue of its own research and development, IBM has obtained more than 10,000 patents which are freely licensed.

I therefore cannot fully agree with Telex's contention that "IBM did not gain, nor has it maintained its position in the industry through skill, industry and foresight". No doubt it gained a dominant position in the industry through a praiseworthy degree of these qualities. Whether there was anticompetitive conduct that went along with them in recent years prior to 1969, the record does not disclose.

The real problem here is notwithstanding this, whether IBM has maintained its monopoly position, or attempted to do so, by unlawful conduct since 1969. In the respects determined herein in the critical period at least it must be recognized that its diligence and foresight have included the competitive studies and the anti-competitive objectives and intent heretofore found, and that particularly as applied to this case have included an attempt to substantially constrain or destroy its plug compatible peripheral competition by predatory pricing actions and by market strategy bearing no relationship to technological skill, industry, appropriate foresight or customer benefit.

With such intent and objectives manifest with respect to its plug compatible competition, it is understandable that the defendant should be particularly opposed to the recognition, as essentially separate entities or markets, of what was initially a part and parcel of its own internal business over which it exercised legitimately a 100% control—the peripherals attached to its own developing system.

But we find unconvincing the idea that separate markets or submarkets actually recognized by IBM itself in this dynamic and amazing industry could not have been developed eventually from IBM's prior lawful domination of it; or that the objectives and planning of such a presently dominating force against the competition of the peripherals could somehow be deemed dissipated among lower echelons of this great organization and not considered to be reflected in the competitive actions of top management, or that, if reflected, should be held innocuous or futile, or at all events lawful, as competitive weapons.

VII. IMPACT AND DAMAGES FOR ANTITITRUST VIOLATIONS

F113. Telex now claims that its damages resulting from unlawful predatory acts of IBM total $361.3 million, and that these damages are comprised of $257.7 million in deprivation of market share, $92.3 million for lost rental profits and $11.3 million for lost sales profits.

F114. The record leaves little room to question that the acts, conduct and intent on the part of the defendant found herein to have been in violation of Section 2 of the Sherman Act proximately caused substantial impact and damage to the business of the plaintiffs, and the court so finds.

Aside from its quantification beyond substantiality, such impact is to be found in the circumstantial evidence as a whole, the direct evidence by way of opinion and judgment of Telex officers and witnesses, some evidence elicited by the cross-examination of the defendant's witnesses, the admitted fact that such acts were competitive responses on the part of IBM to the inroads the plug compatible competition was threatening and making against its market position, by reasonable inference in view of IBM's market domination and organizational effectiveness that these responses must have advanced their purposes to some appreciable degree, and from a number of statistical indications to be referred to in some detail in connection with a determination of the amount of damages to which plaintiffs are entitled.

F115. As to any specific amounts of damages awardable in this given case the evidence is less clear, and as justification for the sums asked for quite unsatisfactory and insufficient. There is evidence tending to show that Telex had a taxable income of $12,462,000 for fiscal year 1971; for fiscal year 1972, after the effects of the 2319 announcement were expectable, Telex's loss was ($913,000), and for fiscal 1973, after 2319 and the FTP influence, its pre-tax loss was estimated to be approximately ($7 million). Its gross receipts of $77,843,000 in fiscal year 1971 declined to $56,076,000 in fiscal 1972.

At the end of fiscal year 1971 (after 2319 but before FTP) the market value of Telex's stock was $19 a share or $197,999,000 for all shares; two years later, after FTP, it was $4.60 per share or $48,143,500 for all shares, a loss in value of $149,855,500. According to Telex's November, 1970, forecast and product plan, a profit of $33,837,000 would have been produced in fiscal years 1972 and 1973. Telex's initial November, 1970, forecast showed a projection of 8,910 units, and Telex actually shipped 4,517 units through March 31, 1973.

Following the 2319A and B announcements and FTP, Telex had been able to make third party sales of $30 million from January 1, 1971, to March, 1973, while in 1969 and 1970 almost $120 million in Telex tapes and disks were sold to third parties. Prices at which equipment could be sold has eroded some 35% as compared to the 1969 and 1970 prices. Marketing expenses increased. Backlog and order rates were reduced. Recruitment of adequate personnel became more difficult as uncertainty as to Telex's future viability increased. "Front end" expense has been increased by inadequate concentration of products and services.

Competition among Telex and other plug compatible manufacturers for remaining business has intensified. Telex's ability to secure financing has been impaired, and Telex has had to pay more for financing. There is some evidence that Telex's problems are not unique in the plug compatible market; that some companies following 2319 and FTP failed in or abandoned their plug compatible business.

There was a "plateau" that existed in Telex's installations growth from about November, 1971, to about July, 1972. From September, 1969, to November 1971, Telex's domestic installation or "population" of peripheral devices increased from 1,000 units to 8,000 units. From about November, 1971, to about July, 1972, the last month included in the Telex chart reflecting such plateau, Telex's installations neither substantially increased nor decreased.

F116. There was evidence developed by IBM at the trial that Telex's forecasts were untried and unrealible upon which to base damage and impact claims and that in any event, the recorded business experiences of Telex were explainable by various factors and influences unconnected with IBM's business practices. It dismisses Telex's income tax returns as unreliable for the purpose of indicating damages, pointing out that in 1972 Telex changed for tax purposes from the accrual method of accounting for certain revenues to the installment method; thereby slowing down the tax reporting of revenues on certain leasing company transactions. The tax return handling of depreciation of Telex's retained equipment and interest expense is also attacked.

The necessity of a detailed and complex analysis including a reclassification of all items of expense and revenues is emphasized by IBM and in the absence of such a study and restatement it is asserted that the income tax returns have little or no value for comparative purposes or even as statements of actual income. The significance of stock price changes is also dismissed by IBM, it being claimed that there is no evidence relating the fluctuations or declines in the market prices for Telex stock to any or all of the IBM actions of which Telex

makes complaint, and that such stock fluctuations are assignable in whole or in part to adverse publicity over IBM's accounting methods and other circumstances over which IBM had no control.

Finally, IBM demonstrated with some persuasion that Telex's difficulties at least in part stemmed from its own problems of management, testing, service, organization and personnel. Defendant's charts 143, 144 and 145 indicate that while Telex disk drive spindles and tape drives installed on CPU's manufactured by IBM leveled off markedly in number for the period 1971–1972, as Telex showed, similar non-Telex installations continued to appreciably advance.

In the latter connection it is notable, however, that about the time the acts complained of by Telex were becoming effective to the extent they did, there was a discernible diminution in the rate of increase of even these non-Telex installations. Telex's response to the claimed adverse effect of its management and other internal problems is that they are more or less normal to the industry and that most of them have been intensified to critical stages because of IBM's predatory actions.

Telex says that the February 7, 1973, product forecast from which IBM concludes that "Telex has turned the corner" is only a manufacturing capability forecast in support of which at the time of the trial it was not assured that adequate financing and third party sales would be available that the order rate is nowhere near the forecast, that since the first of the year there has been a significant reduction in the level of product shipments and new production units shipped for this fiscal year are 50% lower than forecast.

F117. My task would be simpler if as to each element of claimed damage clear and unhampered causal lines could be discerned, leading to IBM's predatory acts without passing through or commingling with the literally hundreds of other circumstances which may have influenced the figures. But in cases like this, if not in every complex case, it is humanly impossible to trace, find, and specify in detail and quantity in effect the numerous circumstances which cause or contribute to financial consequences. By such a process the determination of damages by court or jury could be bogged down in almost any case or rendered more inaccurate than a considered judgment appraisal of the combined effect of all actionable elements duly considered by an informed fact finder after elimination of the influence of extraneous causes. The record fragmenting of judgment might be either a mere exercise in futility or a mechanical allocation of the result of the aggregate judgment at best.

It is the damage that must be quantified rather than the respective weights or contributions of the unlawful causes so long as each has substantial effect upon the damages suffered by the injured party so as to constitute their proximate cause. Notwithstanding the difficulty involved, I have found that there is reasonable basis in the evidence to fairly approximate the damages to which plaintiffs are entitled as proximately caused by the unlawful acts and conduct of the defendant.

F118. The largest component of the damages claimed by plaintiffs relates to the deprivation of market share, based on the difference between Telex's forecast of November, 1970, and Telex's forecast of January 12, 1972. Product rental prices in effect prior to 2319 were used, product life was based upon IBM estimates, and Telex's usual product and marketing expenses were used.

Telex's November, 1970, forecast was prepared prior to the predatory actions of IBM except for the 2319A announcement. The number of units was smaller than those forecast for Telex by IBM's April 16, 1971, internal forecast, which took into consideration the impact of IBM's 3420 tape price cut and IBM's 2319 disk drive pricing cut.

Telex's January 12, 1972, forecast reflected anticipated product shipments greater than Telex's actual business turned out to be over the same period. The difference between the Telex November, 1970, and January 12, 1972, forecasts was less than IBM's internal documents indicated that it expected Telex to receive prior to IBM's Fixed Term Plan announcement.

IBM's internal documents indicated that IBM calculated its increased profits that would result from adoption of the Fixed Term Plan leases for tapes, disks and printers to be $466 million.

Using the latter assumption and considering that in 1970 Telex was installing approximately 53% of the non-IBM plug compatible tape drives, 31% of such disk drives and 100% of such plug compatible impact printers, a calculated loss of market share from FTP would be $218.67 million. In support of its loss of market claim Telex also cites income tax records and stock prices

as indicated above, but relies primarily upon a comparison of documents described as the November, 1970, forecast and a January 12, 1972, forecast.

F119. There are circumstances relating to these forecasts which preclude their acceptance at face value notwithstanding some supportive evidence of other types. The handwritten documents assembled as the November, 1970, forecast were prepared by different people at different times. No part of the document is actually dated and the text of the initial pages indicates a date of preparation after February 18, 1971, even though Telex prepared an entirely new and substantially reduced forecast in February, 1971.

Neither the November, 1970, forecast, nor the January 12, 1972, forecast is supported by the usual written assumptions which the evidence shows were utilized in their preparation. Forecast assumptions were "very informal and very unstructured" in the words of one of plaintiffs' witnesses.

The Telex calculation is based upon the highest forecast it made for selected products compared with the lowest forecast made for those products and the forecasts had no substantial history of reliability or accuracy.

Under such circumstances, while these forecasts have been considered to be good faith evaluations in the course of business operations and for business rather than litigation purposes and thus entiled to consideration, calculations based upon them must be weighed with due regard for their limitations and other evidence.

Moreover, plaintiffs' calculations have assumed that variation in units forecast was caused solely by the IBM actions complained of, or to be found as unlawful by the court, without giving weight to the effect of established internal difficulties within Telex over which IBM had no control and the claimed unlawful integration action that has now been found to have been nonactionable.

F120. These and other limitations in the sufficiency of plaintiffs' proof to support their claim for deprivation of market share in full leave the question whether any such claim is thereby defeated entirely or, if not, what amount of damages has been established by way of fair approximation on the evidence in view of the fact that IBM's predatory actions have deprived the plaintiffs of the opportunity of positive proof of what their experience would have been in the absence of such action.

There must also be evaluated in any award the question of to what extent the uncertainty of proof relates to IBM's predatory action and to what extent, if any, it relates to any inexcusable failure on the part of the plaintiffs to submit evidence reasonably available to it. As to the latter problem, if trial counsel is not to be hindsighted, I am inclined to believe that generally speaking the plaintiffs must be considered to have submitted the best proof of which the nature and complexity of the case reasonably were susceptible.

There is no evidence that there were any better forecasts available nor any indication that those used were contrived particularly for the purpose of prospective litigation. The opinion evidence was based on plaintiffs' theory of liability and as it turns out it would have been more applicable had it been based upon the court's findings after trial of what conduct was lawful or unlawful rather than upon pre-trial expectations or hopes concerning bases of liability.

Beyond such forecasts and opinions, it is difficult to see how loss of market share could be established with any specificity, or how elements of loss of market share could be traced and evaluated much more in detail with reference to various factors that may have entered in by way of possible influence. To attempt by expert testimony to evaluate and weigh each individual factor and to categorize and evaluate the relative influence of each alleged predatory act against the possibility that the court might not sustain contentions as to some of them might so complicate a trial, extend the evidence and compromise the trial position of a party from the inception as fairly to be considered impractical and unjustified.

While the question is not free from doubt, it appears to the court that any uncertainty concerning the amount of the loss of market share is not so ascribable to fault on the part of plaintiffs as to deprive them of the benefit of the rule that where the existence of impact and damages have been shown by a preponderance of the evidence, reasonable approximations of the extent of damage based upon the reasonably available evidence is not to be rejected.

F121. It has been found that sufficient evidence was introduced to show preponderantly that plaintiffs suffered substantial damages in an ascertainable approximate amount from the unlawful acts of the defendant in deprivation of the market share that it would have enjoyed had the unlawful acts of the de-

fendant not been committed, and that taking into consideration the strengths and weaknesses of he plaintiffs' proof as to damages in view of the whole record, eliminating the results of internal, collateral or other considerations over which IBM had no control and unrelated to its unlawful acts, and excluding damages for lost rental profits and lost sales profits hereinafter to be separately considered, such element of damage reasonably awardable herein amounts to $70 million.

F122. It has been found that sufficient evidence has been introduced to show preponderantly that plaintiffs suffered, from lost rental profits, substantial damages in an ascertainable approximate amount from the unlawful acts of defendant, and that taking into consideration the strengths and weaknesses of plaintiffs' proof in view of the whole record, and eliminating the results of circumstances over which IBM had no control and which were unrelated to its unlawful acts, such element of damage reasonably awardable herein amounts to $39 million.

This sum represents the difference in profits from Telex's installed units based upon rental charges actually received and that would have been received in view of defendant's unlawful acts, as compared to rental profits that would have been received on rental prices in effect prior to IBM's 2319 and FTP announcements, with elimination of factors not attributable to IBM.

Approximately $20 million of this total amount is made up of past and future claimed lost rentals on all Telex shipments prior to April 1, 1972. The other $19 million is lost rentals on shipments reasonably to be anticipated as taking place after March 31, 1972.

F123. Telex's claim of $11.3 million damages for "lost sale profits" from leasing company transactions is based on a reduction in the price and sale "multiples" as a result of IBM's pricing actions. Telex claims $8.5 million in lost profits on the Pepsico transaction, $1.3 million on the Hudson disk transaction, and $1.5 million on the Transamerica disk transaction.

As in the cases of other classes of damage claimed by Telex, I find generally speaking that plaintiffs' witness Heavener properly analyzed and applied the formula for fixing damages to the data and assumptions available to him, the accuracy of the results being limited by the limitations of these data and assumptions. I cannot agree that a comparison of sales multiples in different third party agreements and other possible variables pressed by defendant indicate neither the fact of injury nor the amount of damage.

The variables were explored or touched upon in a general way in the evidence as are other possible adjusting factors. I am convinced that allowing IBM the maximum reasonable benefit of these and other possible variables would not decrease Telex's claim of lost sale profits from leasing company transactions by more than $2.8 million, or roughly 25%, and that other objections to the validity of the plaintiffs' figure adequately have been met by the evidence.

Accordingly, I find actual damages suffered by plaintiffs in lost sale profits proximately caused by the defendant's unlawful acts amount to be $8.50 million.

F124. Accordingly the court finds that as a proximate result of IBM's unlawful acts and conduct the plaintiffs have suffered actual damages totaling $117.5 million. It is further found that this is a fair and reasonable approximation based on the evidence before the court.

It is believed in this connection that any greater amount, while it could be considered supported by some evidence, would be speculative and not supported by preponderant evidence applying the rule of liberality commended by the authorities. Weighing all relevant factors on the whole record, it is believed that any less award would be contrary to the preponderance of the credible and sufficient evidence.

VIII. EQUITABLE RELIEF ON ANTITRUST CLAIMS

F125. The court further finds that defendant threatens to, and will unless restrained by the following equitable relief, continue its unlawful conduct to the irreparable injury of plaintiffs and of the industry and the public generally, but with the damage and equitable constraints herein provided it is likely that such further injury can be avoided.

To reestablish and maintain competitive environment in the market, IBM's ability to exert monopoly market power and control the plug compatible industry and particularly the relevant submarkets for magnetic tape products, disk products, printer products, memory products and communication controllers should be limited by the following equitable relief.

F126. International Business Machines Corporation should be permanently enjoined from enforcing or collecting any contractually specified penalty payments which it otherwise might be entitled to collect because of termination upon ninety days' notice of any long term lease agreements heretofore entered into between IBM and any of its end-user customers, including but not limited to IBM Fixed Term Plan leases, Extended Term Plan leases and Term Lease Plan leases.

For a period of three years from and after the date of this judgment it should be enjoined and prohibited from including in any lease agreement for electronic data processing products for terms in excess of 90 days any provision requiring payment of any liquidated damages or penalty because of a customer's earlier termination of said lease agreement.

F127. At the time of a product announcement concerning any peripheral EDP product, or at the time of release for manufacturing or production, whichever first occurs, International Business Machines Corporation should be enjoined and required to publicly describe and disclose the design of the electronic interface for such product essential for connection to a CPU or its channel, in sufficient detail as to render reasonably feasible the reproduction of such interface by other qualified manufacturers; and within 60 days from the entry of this judgment International Business Machines Corporation should be ordered to similarly describe and disclose the details of the design of the electronic interface for each System 370 peripheral EDP product announced heretofore.

F128. International Business Machines Corporation should be enjoined and prohibited from single, or "bundled" pricing of memories with its System 370 central processing units, that is, from charging a single price for both the central processing unit and the memory, and within 60 days from the entry of the judgment herein IBM shall separately price its CPU's and memories.

This should not prohibit, restrict or enjoin IBM from selecting the physical locations of its products so long as these requirements and those stated in the next succeeding paragraph are followed.

F129. International Business Machines Corporation should be enjoined and required to separately price its functionally different products, including memories, tape products and their controllers, disk products and their controllers, printer products and their controllers and communication controllers regardless of whether it elects to place such products in single cabinets or in multiple boxes or cabinets.

International Business Machines Corporation should be further enjoined and required to set its prices for all such functionally similar EDP products by using and applying a substantially uniform percentage markup over actual design, manufacturing and marketing costs as between such integrated and separately boxed products.

F130. International Business Machines Corporation should be enjoined from adopting, implementing or carrying out predatory pricing, leasing or other acts, practices or strategies with intent to obtain or maintain a monopoly in the market for EDP peripheral equipment plug compatible to its CPU's, or any relevant submarkets thereof.

F131. Since I have found evidence insufficient to establish that IBM actually implemented with monopolistic intent or without reasonable cause suggestions made internally that as a competitive strategy it withhold from the public existing, available and developed technology relevant to specific product announcements to frustrate plug compatible competition, and because it is believed that any requirement that IBM describe all product enhancements that are planned or anticipated to be made to a product during its product life would be competitively unreasonable and inhibiting to technological developments in the industry, requested injunctive relief in this respect should be denied.

Nor do I believe the evidence warrants the order of divestiture sought by plaintiffs, it being my view that the damages and equitable relief abovementioned in connection with normal corrective trends in the industry, will serve to obviate the found monopoly and to restore a healthy competitive climate within a reasonable time, if the enjoined acts and conduct are discontinued or carried out, as the case may be.

IX. IBM'S COUNTERCLAIM AGAINST TELEX FOR UNFAIR COMPETITION, MISAPPROPRIATION OF TRADE SECRETS AND PROPRIETARY INFORMATION

F132. Telex's first plug compatible tape drive, its Model 4700, was offered to the market in 1966 to compete with IBM Model 729, which had then been on the

market for a number of years. Telex's second plug compatible tape drive, its Model 4800, was delivered to the market in 1967 to compete with IBM Model 2401, which had been on the market for several years. Telex's next plug compatible tape drive, its Model 5420, was delivered to the market in December, 1970, to compete with IBM Model 2420 which had then been on the market for more than one year.

Telex's current tape drive subsystem, being its Model 6420/6803–1, was delivered to the market in November, 1971, to be plug compatible to the IBM channel interface of the System 360, which had been on the market since 1964. This model was likewise competitive with IBM tape drive subsystem model 3420/3803, which had been announced by IBM in November, 1970.

Telex's plug compatible disk drive, its Model 5311, was delivered to the market in 1969 to compete with IBM Model 2311, which had been on the market for about five years. Telex's disk product was a disk drive subsystem, its Model 5314, which was plug compatible to IBM CPU's and was delivered to the market in April of 1970.

The said model was competitive with IBM Model 2314 which had been on the market since 1965. Telex's current disk drive system, its Model 6330/6830, was delivered on the market in October of 1972, to compete with IBM's Model 3330/3830, which had been announced in June of 1970 and first delivered in August of 1971, since which date it had been on the market.

Telex also manufactures and markets semi-conductor main memories which are plug compatible to IBM CPU's. These were first offered in November of 1971. IBM offers a variety of main memories with which the Telex products compete. Telex also manufactures a plug compatible printer system, its Model 5403/5821, which was offered on the market in November, 1970, to compete with IBM Model 1403N1/2821, which had then been on the market for several years.

F133. As already found, Telex's business has been largely directed toward offering plug to plug interchangeable replacements for products manufactured by IBM. The lower prices by which Telex induces such customers to replace IBM equipment with Telex equipment are achieved by copying as closely as possible the IBM design. In order to maximize its return on investment, Telex has attempted to bring its plug compatible replacements to the marketplace as soon after IBM announces its products as possible.

The life cycle of the Telex plug compatible products is dependent on the life cycle of IBM products to an important measure since Telex generally has not marketed products of independent design but rather has waited until IBM has designed a product which Telex plans to replace. Telex has been motivated to determine the specifications and plan for new IBM products as soon as it is able and, if possible, before the products are announced to the public. One of the ways it has found to implement this objective has been the hiring of IBM employees or former employees.

F134. Statistically, the number of IBM employees hired by Telex has not been impressive. Of those personnel who had formerly been employed by IBM some of them were employed by Telex after intervening employment by third parties and some were employed immediately after the termination of their employment at IBM. On March 31, 1970, Telex employed 50 engineers of whom one was a former employee of IBM. On March 31, 1971, Telex employed a total of 88 engineers, of whom 18 were former IBM employees, 8 of these were employed directly from IBM. On March 31, 1972, Telex employed a total of 145 engineers, of whom 31 were former IBM employees; 13 of these were employed directly from IBM positions. On March 31, 1973, Telex employed a total of 129 engineers, of whom 12 were former IBM employees; 3 of these were employed directly from IBM.

The remainder of Telex's engineering staff was employed after no previous IBM experience. They were obtained either directly from schools or with work experience from self-employment or from some 60 other employers. One of the principal sources of engineering personnel was RCA, which abandoned its electronic data processing venture in 1971; a total of 32 of Telex engineers employed as of March 31, 1973, came to Telex directly from RCA. On March 31, 1973, Telex had total employees of 1,929, of whom 152 had former IBM employment experience.

F135. However, it must be recognized, complementary to these figures, that former IBM employees have furnished an important and vital part of Telex technology and business development. In March, 1970, Telex hired IBM employee Jack James who possessed substantial confidential information about IBM's future product plans.

At the suggestion of Telex Vice President of Sales, Grant, who had worked with James at IBM, Telex contacted James in January, 1970, regarding the pos-

sibility of his resigning from IBM and taking a position with Telex. He had been employed as the Systems Requirement and Business Manager for the General Systems Division of IBM and was in a position of responsibility relating to planning for various IBM products and services.

In the course of his duties at IBM, James had access to confidential data relating to IBM products under development and relating to IBM's forecast and financial information. While James was still an employee of IBM, but considering employment by Telex, he provided Telex Chairman Wheeler with an appraisal of the wisdom of Telex's entering into the marketing of terminal products and with advice as to what types of products Telex should offer in the future.

After returning from a meeting with Telex executives, James returned to IBM and collected a substantial quantity of IBM planning data, including shipment forecasts, with respect to IBM products as to which Telex offered plug compatible replacements and, in addition, with respect to IBM's printer products. James was offered the position of Vice President of Finance for Telex Computer Products Inc., and accepted that position in March, 1970.

F136. James had no contract with IBM for a fixed term of employment and had made no agreement not to accept employment from a competitor of IBM; but he understood that he should not disclose IBM's secret or confidential information or documents, and prior to his leaving IBM he had a termination interview in which his obligations with respect to IBM trade secrets and business confidential information such as marketing analysis, product costs and plans for potential new products were discussed. On March 23, James acknowledged these obligations in writing.

F137. It was natural, proper and to be expected that James's general knowledge of electronic data products, both of IBM and its competitors, his knowledge of the markets exisitng therefor, or anticipated to exist therefor, his knowledge of price performance factors, of equipment available in the market, and his acquaintance with sales and marketing problems relating to such equipment, including competitive factors, were the currency of his qualifications for any position he might accept.

It was natural and proper, also, that his general knowledge and opinions respecting the then existing future markets for electronic data processing equipment, and even limited general notes of information or opinions respecting the fields of his employment which he had made as a part of his work experience, would be carried with him into any future employment.

Beyond this, it might have been reasonably expected that he would utilize in his new employment the totality of his general knowledge concerning the EDP industry, his general judgment based upon the sum total of his experience and his experience and competence derived from dealing with the problems and plans of his former employer, IBM.

F138. But beyond this, I am compelled to find from the evidence as a whole that Telex expected, and James intended as a part of his new employment, to capitalize and exploit confidential IBM documents and studies themselves. Prior to leaving IBM James had access, among other things, to IBM's Plan 25 Forecast and IBM's SCAN forecast assumptions.

James knew that the Plan 25 Forecast and the SCAN Forecast assumptions were IBM confidential documents and entitled to protection as such. He took with him from IBM to Telex confidential information copied from the Plan 25 Forecast and from the SCAN Forecast assumptions, including information on IBM Forecasts; IBM product announcements and information about the performance of its products.

Beginning immediately after he joined Telex, James prepared and disseminated to other top officials of Telex a series of memoranda which disclosed the IBM confidential information in his possession relating to unannounced IBM products and to IBM future business plans and projections, which disclosures were in detail and specific, negating any idea that they constituted merely general information or opinions based upon his experience.

Beginning in March, 1970, based upon IBM confidential information with respect to peripheral equipment to be attached to the NS series of CPU's later announced as System 370, Telex adopted new business and product plans.

On March 26, 1970, James told Martin of his intent to revise Telex's budget based upon "new market forecast information that should result in higher projections of revenue, profit and cash requirements and a constant or slightly reduced expense picture." On April 15, 1970, a two day off-site business planning meeting was held by Telex's four top officers to discuss "financial analysis of present products and growth strategy".

The material which provided the basis for the discussions at the meeting was confidential IBM market forecast and product information prepared by James and disseminated just prior to the meeting. The materials which James prepared consisted of forecasts of installations of IBM CPU's and certain IBM and Telex peripheral products in the United States and overseas for the years 1970–1975, together with recommended product strategies based on IBM forecasts.

The SCAN forecast assumptions and the IBM Plan 25 forecast to which James had access and utilized for the benefit of his new employer were registered IBM confidential documents. The designation "registered IBM confidential" indicates a specially controlled document containing highly sensitive trade secrets for IBM's condential information.

F139. In the ensuing months James disclosed further IBM confidential information which was used in forming Telex's product strategy and in determining Telex's development program. On June 11, 1970, James proposed to TCP President Martin that Telex enter the business of offering plug compatible replacement memories for NS Systems.

James's recommendation was based on his knowledge of the unannounced prices for NS memories and confidential forecast data with respect to those products. On July 20, 1970, President Jatras reported to Telex's board of directors that Telex had just adopted the objective of offering plug compatible memories for IBM systems.

Telex officers and employees thereafter engaged in a concerted effort to recruit IBM memory engineers and to discover technical and business confidential information through that recruiting process, to gain access to proprietary documents locked in cabinets under the jurisdiction of IBM's maintenance personnel and otherwise to obtain proprietary information concerning IBM's NS or System 370 memories.

On June 15, 1970, James provided Martin with an assessment of "the IBM printer strategy and my opinions on how Telex should counter". This strategy was based on Jame's knowledge of unannounced printers and card products being developed at IBM and the planning assumptions for those products.

On June 15, 1970, four days after his memorandum on memory programs and the date of his memorandum on printer strategy, James provided Martin with an assessment of IBM's "Aspen Intermediate" tape drive and controller development program and a recommendation as to the direction Telex's development program should take.

Based at least in substantial part on the disclosures by James of IBM business confidential information with respect to tape, disk, memory and printer products developed by IBM. Telex took a series of actions in 1970 designed to add comparable products to its product line and thereby reduce the competitive advantage to IBM of conducting independent research and development efforts. By the end of 1970, the Telex product line was becoming significantly broader and more competitive than it had been at the end of 1969.

F140. The court finds that James deliberately misappropriated IBM confidential information and made that information available to Telex, and that principal officers of Telex knew, or should have known, that the information made available to Telex was confidential IBM information and that it had been wrongfully misappropriated by James.

F141. Beginning with the hiring of James and continuing at least until commencement of this lawsuit, Telex followed a practice of acquiring as an important part of its business IBM confidential information and trade secrets through the hiring of IBM employees with knowledge of such confidential information and trade secrets.

In July, 1970, Telex hired Howard Gruver from IBM with the intent of obtaining confidential information concerning IBM's unannounced advanced tape subsystem, Aspen. In November, 1970, Telex hired John K. Clemens with intent to obtain IBM's confidential information concerning its advanced disk subsystem, Merlin. In or prior to November, 1970, Telex obtained a copy of the Registered IBM Confidential document, the Storage Products Five Year Plan.

In May, 1971, Telex acquired a copy of portions of the IBM confidential document 27BN Communications Control Unit Phase I Forecast Assumptions. Prior to July 6, 1971, Telex furnished a copy of the Storage Products Five Year Plan to McDonald who prepared a technical report for Telex based on that document. In June of 1972, James ordered former IBM employee Kevill to provide him with product descriptions and market forecasts for unannounced IBM advanced disk products and Kevill complied with that request.

In August, 1972, James ordered Jones to hire IBM employees to build a device patterned after Birch, an unannounced IBM product. About six months prior to March 6, 1973, Telex's President James sent to Howard Gruver IBM confidential information concerning the forecast assumptions for the Storage Products Five Year Plan. During 1971, Telex made a copy of the IBM Friend 2 source diagnostic program, a confidential IBM diagnostic tool.

F142. In April, 1970, at a business planning staff meeting, Telex decided to proceed with a tape controller program and as the first action it determined to "identify and recruit from IBM a project engineer with tape controller experience and 'Aspen' capability". In January, 1971, Wheeler reiterated his prior order to hire a manager for Telex's memory system program from IBM.

He noted that Telex would benefit in that "in our efforts to employ the right man we will unquestionably learn what IBM is planning to do in this area which will be a great assistance to us in planning our future strategy." Desmond Jones told Martin that one of the prerequisites for a Telex Memory System's manager was previous active participation in the design phases of IBM's System 370 memory, and Martin then instructed Jones to hire a memory manager with IBM System 379 memory design experience.

In August, 1971, in assessing the hiring of Moore, Telex's Desmond Jones noted as a positive factor that Moore had knowledge of IBM's future plans. An important factor in the consideration of the employment of IBM engineer Roosseim was that he had had the experience designing the IFA for the System 370/145. Grant in 1972 said that Telex must have IBM talent in the disk area in order to stay current, and on another occasion recommended to James adoption of a hiring policy making "IBM competence a prerequisite" to employment.

In June, 1972, Telex employee Deck noted that in the area of advanced disk development "clearly it is most desirable to get IBM or ex-IBM talent . . . The only viable alternative is talent from independent disk and head companies who are cognizant of IBM's plans".

In June, 1972, Desmond Jones wrote to Jack James that he had undertaken to recruit the necessary talent to answer questions regarding the functional definitions of various disk programs. Jones stated that "I do feel the need for IBM talent has become considerably more important since we are trying to compete against yet-unannounced products. Thus we will most certainly concentrate on getting IBM talent for not only the disk, but for the memory, advanced tape, and software programs."

In a June 8, 1972, disk program proposal, Deck stated, among other things, that "what we are after is not skill per se but information. The best source of people with required information is current or recent employees of IBM's disk development group". Bangel, in a memorandum to Desmond Jones in regard to Blunk, noted that "Telex has a requirement for the type of experience Blunk has had at IBM.

Those areas where I feel he could aid Telex are as follows: 1. 370/158–168 memory design; 2. compatible main frame design; 3. backup support to present 370 memory design; 4, recent knowledge of IBM plans and design schemes." In September, 1972, Jones wrote to James concerning the employment of IBM engineer Glen Day. Jones was interested in Day because of his IBM experience with a new terminal. Jones said, "As yet this product has not been announced but from my information today it appears it would contribute a significant part to any communications program and might well give us a jump on IBM."

F143. None of the IBM employees hired by Telex had any contract with IBM for a fixed term of employment: nor did they have any agreement or contract not to accept employment by a competitor of IBM. All of them had either expressly contracted to respect IBM's confidential information and trade secrets or had impliedly undertaken to do so by reason of briefings, discussions or general conditions of employment at IBM.

Few, if any, of the former IBM employees employed by Telex who testified at the trial or by deposition admitted expressly that they had delivered or revealed IBM trade secrets or confidential information to Telex, and most of them expressly testified by way of summary or conclusion that they had not.

But by reason of Telex's massive and pervasive policy, some direct evidence, and overwhelming circumstantial evidence to the contrary, the court must find that in numerous instances IBM's trade secrets and confidential data which it was entitled to have respected by former employees were revealed to, and utilized by, Telex; and that in combination, and by reason of a planned and intended program to this effect, these revelations transcended any acceptable utilization of the

employees' general expertise, training, experience and capabilities and constituted an unacceptable program of industrial espionage and unfair competition.

F144. IBM's 3420 tape drive and 3803 tape drive controller were announced in November, 1970, and first shipped to customers in September, 1971. Telex's 6420 tape drives and 6803 tape controller, which were offered as replacements for the IBM 3420/3803, were announced in December, 1970, and first shipped to customers in November, 1971.

The IBM 3420 and 3803 had been deevloped by IBM under the code name "Aspen", beginning in January, 1969. The basic design work on the Aspen technology had gotten underway in 1966. The Aspen control unit and tape drive embodied significant new technology. The innovations in Aspen resulted largely from 17 specific design characteristics which represented trade secrets in combination and, in certain respects as individual components, particularly in their application to tape devices.

All 17 of these design characteristics and their combination, as embodied in the Aspen tape drive and controller, were treated and protected as confidential information by IBM. The first intended disclosure by IBM of any of the Aspen design characteristics occurred in November, 1970, when ten of the seventeen characteristics were disclosed by the public announcement of Aspen. This disclosure was of the existence of their features, not their design or method of implementation.

F145. In April, 1970, approximately seven months before the Aspen tape drive and controller were announced by IBM as the 3420 and 3803, James discolsed information about the confidential Aspen program to the management of Telex. On the basis of that information, Telex decided to design, manufacture and market a plug compatible replacement for Aspen.

An important method by which Telex intended to design such a product was to recruit away from IBM an engineer who was working on Aspen and to employ him in the designing of an Aspen type product for Telex. In July, 1970, Telex management hired Howard Gruver, the IBM engineer in charge of the Aspen control unit development project, with the intent that he build for Telex an Aspen type control unit using the knowledge and information which Gruver had accumulated at IBM.

Gruver was offered a salary of $35,000, a guaranteed bonus of $5,000, and options on 2,500 shares of Telex stock, the total compensation package being more than twice Gruver's compensation at IBM. Gruver knew from the time he was hired that Telex had hired him to take advantage of his Aspen experience and knowledge of IBM's N/S technology and thereby to get a head-start with Telex's replacement for Aspen.

F146. When he joined Telex, Gruver was under an obligation not to disclose any information with respect to the design characteristics of Aspen. On March 15, 1965, Gruver had executed an employee confidential information and invention agreement with IBM. This agreement obligated Gruver not to disclose any IBM confidential information to others either during or after his employment with IBM.

Upon leaving IBM, Gruver was informed in an interview and letter, which he acknowledged in writing, of the trade secrets and other IBM confidential information which he was obligated not to divulge. Such trade secrets and IBM confidential information included information concerning IBM's data storage and retrieval technology programs and concepts, head development programs and concepts, and current programs and concepts concerning various aspects of tape handling and processing, and any information regarding products that had not then been announced.

In violation of his obligation Gruver used his knowledge of IBM's trade secrets with respect to the design to the unannounced Aspen tape products to design for Telex a replacement version of Aspen.

F147. Largely because of Gruver's disclosure of the IBM trade secrets relating to Aspen, Telex was able to incorporate in its 6420 tape drive and 6803 control unit the design characteristics of the Aspen control unit and tape drive before they were announced by IBM, to announce its 6803/6420 Aspen replacements a month after IBM announced the 3803 tape drive controller and 3420 tape drive, and to deliver the 6803 and the 6420 two months after IBM delivered its 3420 and 3803.

Telex's engineering department anticipated the announcement of Aspen several months prior to November, 1970, and by the time of the IBM announcement "had significant development work underway".

Gruver told IBM engineer Richard Moore, who was being recruited by Telex, that "he (Gruver) had come to Telex sometime previously and had effectively duplicated the efforts he had—the machine he had made at IBM, at Telex . . ." Telex Sales Vice President, Grant, informed his sales force on November 6, 1970, the day after the Aspen announcement by IBM, that as a result of having hired Gruver the Aspen announcement "held no technical surprises whatever" for Telex and Telex expected to be able to ship its replacement products very shortly after IBM deliveries."

F148. Telex's 6803 and 6420 development program, which incorporated the 17 Aspen design features above-mentioned, consumed 16 months from the commencement of the product program to the shipment of the first unit in November, 1971, and was accomplished by engineers working under Gruver who did not have extensive expertise or experience for the purpose.

IBM's 3803 and 3420 development program consumed 32 months from the commencement of the program to the shipment of the first units in September, 1971, and was accomplished by engineers with extensive tape controller experience.

Products such as the Aspen control unit could not have been designed, developed and manufactured by Telex's independent efforts within eleven months after the IBM announcement of Aspen or even within 16 months of Gruver's joining Telex.

Telex could not have incorporated into the 6803 design the Aspen design features which had not been announced in November, 1970, by reverse engineering those features in the two months interval between IBM's first customer shipment and Telex's first customer shipment.

Since the combination of 17 design characteristics embodied in IBM's Aspen tape control unit and tape drive was the result of numerous trade-offs, the probability that another group of design engineers working independently would arrive at a combination of greater than 10 of those design characteristics would be negligible despite the fact that most of these characteristics in and of themselves and in different and separate context might not be considered secret, innovative or novel, and some embraced techniques well known in other contexts.

F149. The court must and does find that Telex deliberately set out to misappropriate the IBM Aspen trade secrets, hired Gruver as an important step in furtherance of this purpose and succeeded in misappropriating various Aspen trade secrets and incorporating them in the Telex 6803/6420.

Notwithstanding that, as hereinabove found, IBM took approximately 16 months longer to develop its Aspen products than Telex took to develop their replacements. I do not think it necessarily follows that Telex saved 16 months in development time because of incorporating into its design program the Aspen trade secrets disclosed by Gruver.

Telex apart from any trade secret revelations was entitled to, and no doubt did, benefit by the general expertise, knowledge and know-how brought by Gruver to his Telex employment which undoubtedly would have facilitated the design and development of the Telex products had there been no utilization of IBM's trade secrets.

Moreover, it is a fair inference from the circumstances that Telex, from developing related technology regularly released by IBM and otherwise obtainable had an advantage over the pioneer efforts of IBM. Because of these and other related circumstances, while it could be possible that Telex had the full 16 months time advantage by reason of appropriating IBM's trade secrets, the probability is that the advantage thus improperly secured was between ten and eleven months.

F150. From September, 1971, to December, 1972, inclusive, shipments of 6803 and 6420 units represented a total of 3,561 rental months for 6803's and 9,348 rental months for 6420's. The IBM 3803 rents for $675 per month. Using the 16 month differential, had IBM's 3803's been shipped to those IBM customers rather than Telex 6803's, the 3,561 rental months would have resulted in $2,403,675 in rental to IBM.

The average monthly rental price of IBM's 3420 series tape drives is $471.67 per month. The IBM 3420 model 3 rents for $355; the 3420 model 5 rented for $475; the 3420 model 7 rented for $585. Had IBM's 3420's been shipped to those IBM customers rather than Telex 6420's, assuming the 16 month differential, the 9348 rental months would have resulted in $4,409,171 in rental income to IBM.

On the last mentioned bases, through the end of 1972, IBM could be deemed to have been deprived of approximately $6,800,000 in monthly rentals of 3803-

and 3420 units as a result of the accelerated shipments of Telex 6803 and 6420 replacement units made possible by misappropriation of IBM's trade secrets, as contended by IBM.

However, the court is not convinced that loss in that full amount was proximately caused by reason of the factors above-mentioned and other likely variables, but is convinced by what it regards as the preponderance of the evidence that after discounting IBM's claims accordingly and considering the entire record bearing upon this element of damage, the defendant was deprived of $4.5 million in monthly rentals of 3803 and 3420 units. Such result is generally confirmed by consideration of sales actually made by Telex of its 6803 controller and its 6420 tape drive during the ten to eleven months period of advantage.

F151. IBM expended approximately $100 million on the development of Aspen from the start of the program in January, 1969, until the date of first customer shipment; Gruver left IBM approximately half way through the development program and took with him a substantial part of the information developed through the first half of the program at a cost of approximately $5 million.

By what part of those development costs Telex was unjustly enriched beyond the more specifically proved damages above-mentioned, or, viewed differently, what damages, if any, should be allowed for the Aspen misappropriation on a "standard of comparison" basis, is a difficult problem factually, not to mention legally.

In addition to revenue derived from shipping 6803 and 6420 units to users of IBM systems, Telex would have derived an additional indeterminate amount of income from the marketing of the 6803, and 6420 to companies such as Mahawk, Data Systems, Itel, Formation, Xerox, CDC, and Telefunken, for which figures are not available.

There is no doubt that by reason of the improper use of confidential trade secret information of IBM Telex was unjustly enriched to a substantial amount beyond the $4.5 million, but, again, defendant's additional claim of $5 million for unjust enrichment cannot be accepted; it seems more likely that a reasonable amount would approximate, and not in any event exceed, $3 million.

F152. In the first half of 1970, based on IBM information provided to Telex top management by former IBM employee James, Telex made the decision to expand its product line to include disk file subsystems. James provided detailed information to Telex concerning IBM Merlin 3330 and advised that Telex must be in a position to ship a 2314B (Merlin) product by the fourth quarter of 1971 and Telex decided to try and establish an inhouse capability to manufacture a 3330 disk system in mid-1970. Thereupon, Telex adopted the plan of identifying and recruiting from IBM key employees who had developed the subsystem for IBM. During the period 1970, and prior thereto, John K. Clemens was the engineering program manager at IBM for the Merlin project.

Clemens had assumed full responsibility for this project in April or May of 1969, and was fully informed of all areas of the program including but not limited to manufacturing, sales and forecasts in addition to development and design. Telex offered a large bonus to Clemens to induce him to join Telex and recruit from IBM a development team to build for Telex a Merlin competitive product.

On November 22, 1970, Telex and Clemens executed two contracts of employment. Both contracts provided that Clemens would be responsible for the development of a 3330 type disk storage system. The contracts provided for compensation consisting of a salary of $40,000, a bonus based on performance of $500,000, stock options for Telex stock having total market value of $50,000, authorization to offer $500,000 in bonuses and $300,000 stock options to other employees to be recruited.

One contract signed by both Clemens and Telex on November 22, 1970, made the realization of a portion of the $500,000 cash bonus contingent upon delivery of a Merlin system to a Telex customer prior to August 31, 1972. A copy of this contract, signed before copying and again after copying both by Clemens and Telex, was retained by Clemens, under which he operated while at Telex. This contract had no section concerning any new and original design.

A second contract signed both by Telex and Clemens on November 22, 1970, made the realization of the $500,000 cash bonus contingent upon delivery of a Merlin system to a TCP customer prior to November 30, 1972. This contract included a section mentioning a "new and original" design as a prerequisite to the bonus and was retained by Telex. The $500,000 cash bonus offered to Clemens by Telex was the largest bonus offered in the history of the company. After hiring Clemens,

Telex set out to hire other IBM key engineers on the Merlin disk drive and Merlin controller.

Telex offered these IBM engineers extremely large salaries, bonuses and stock options to induce them to join Telex and build a Merlin product for Telex using IBM confidential and trade secret information. The following additional IBM expert employees were hired by Telex for this project: Chartlon, Glover, Hancock, Hou, Ice, Kevill, McGuire and Wilson.

F153. The IBM Merlin had been under development for five years before it was announced in June, 1970. The Telex time schedule called for the development of the Merlin drive and controller to be completed in 18 months.

Wilmer, a prospective employee with IBM experience, told Jatras and Clemens during a meeting in Jatras' hotel room in Palo Alto that to develop a Merlin system in 18 months was unrealistic and that the only way you could meet such a schedule would be by copying IBM's 3330 Merlin system.

Kevill and Hancock indicated to Wade that they wanted him to come to work for Telex and help Telex build an exact replica or copy of the IBM 3830 control unit for a Merlin system. It would have been impossible to have independently developed the Merlin system in 18 months by using only information that was in the public domain or information that was not IBM proprietary and confidential.

The information that had been released by IBM in June of 1970, when Merlin was announced, was only a small portion of that which would have been required to develop the Merlin disk drive. Through numerous other similar statements from Telex officers and employees in connection with its recruitment program and from other circumstances it is apparent that Telex was not primarily interested in a new product design or in an advance in the state of the art through technology developed independently, but rather in a Merlin-type device copied from IBM's design through utilization of IBM information.

F154. IBM considered the Merlin program to be a confidential project and expended a great deal of effort to maintain its confidentiality. When Merlin was announced in June of 1970, the basic functional characteristics were disclosed but the design details of how to achieve the characteristics were not announced or made public.

All of the IBM employees who were either successfully recruited by Telex or whom Telex attempted to recruit had signed an IBM Employee Confidential Information and Invention Agreement at the commencement of their employment with IBM. All of the IBM employees that Telex successfully recruited from IBM to work on the Telex 3330 Merlin type system were reminded prior to their departure from IBM of the particular information they had had access to while employed by IBM and IBM considered to be proprietary, confidential and trade secret information.

F155. Telex officers were conscious of the trade secret problem and on occasion sought to rationalize or differentiate between manners of acquisition and on other occasions to dissemble. Telex corporation President Jatras informed Wilmer that it was Telex's position that there was nothing unethical or illegal in copying an IBM product unless they took IBM drawings or documents.

Jatras had a copy of the complaint in an IBM legal action against Memorex involving alleged trade secrets and assured Wilmer that there was little chance that IBM would be successful in that suit. Kevill and Hancock informed Wade that Telex wanted to build the Merlin control unit in such a way that they would not be sued. Kevill and Hancock told Wade that he would have to disguise the control unit in such a way that it could not be easily proven that it was an exact copy of the IBM Merlin control unit.

Kevill and Hancock indicated to Wade that if he were to be sued for copying the IBM Merlin control unit Telex would provide legal support. In form, former IBM employees were told by Telex officials that they were not expected to utilize IBM trade secrets and on occasion they were expressly forbidden to do so; and generally forme IBM employees were hired on a specified "condition" that they would not utilize nor employ trade sercets or confidential information of IBM.

It is quite apparent from the entire record and the very circumstances of hiring that these latter conditions and directives were largely mere formalizations and protective devices. There is no doubt that a number of the former IBM employees hired by Telex conscientiously endeavored to separate in their minds the detailed confidential and trade secret information of which they had knowledge and which they had retained, from their general competence, and their judgment, expertise and experience of which Telex was entitled to the benefit.

But Telex's necessity for such confidential and trade sec.et information was so manifest, the pressure so great and Telex's program and policy to obtain that information so prevasive during this particular period as to have rendered it difficult if not impossible for engineering personnel to fully protect IBM's trade secrets.

F156. Accordingly, the court finds that Telex deliberately set out to misappropriate the Merlin trade secrets, hired Clemens and other IBM engineers for this purpose, and succeeded in misappropriating a substantial number of those secrets and incorporating them into the Telex 6830, built at the Telex TDAS facility.

F157. The Merlin control unit and disk drive announced by IBM in June, 1970, as the IBM 3830 control unit and 3330 disk drive were the result of a five year development program at IBM, which cost in the neighborhood of $30 million. At the time of announcement six or seven of the features were disclosed but no design information for implementation was included.

The design features listed below were largely new in the context of this device, were individually valuable for the purpose and provided in combination a control unit having improved characteristics over any other which had been introduced at that time.

A substantial number of these features were confidential and constituted trade secrets in the context of the 3830 and the combination of them in the 3830 was new, innovative and constituted valuable confidential information and trade secrets. These were misappropriated by Telex and incorporated in the Telex 6830 prior to the first customer shipment of the Merlin which was made in August, 1971:

Semiconductor read/write control store
4K (4096) words of control store
Microinstruction word of 32 instruction bits and 4 parity bits
Variable format microinstruction word
Use of 4 format definition bits
Use of 2 field suppress bits
Use of a 4 bit CK field
Eight specific ALU operations
Four specific direct branch conditions
Use of a specific bit to gate the CK field
A technique of adding a field to the data address register
Command retry
Rotational position sensing
Record reorientation
Upper–A microinstruction word format
Lower–A Microinstruction word format
Upper–D microinstruction word format
Lower–D microinstruction word format
Error detection and correction capability.

The use of each of these features in the Merlin, and their details, were known to one or more of the following IBM employees hired by Telex from IBM: J. K. Clemens, Robert J. Hancock, Sterling Hou, W. Edward Ice, B. O. Glover, and J. Kevill. The Telex Meriln 6830 disk file control unit produced in 1971 by the Telex TDAS group at Santa Clara, California, prior to delivery to customers by IBM of the first IBM Merlin disk file control unit embodied all of these design features.

F158. It is true that some of these features were in general context neither new, novel, secret nor innovative; but they all had considerable value in addition to their value as separate elements since they represented a design composite which allowed IBM to achieve its goals of the 3830 in terms of cost and performance, and since their use was calculated to put Telex in a position to compete upon a comparable basis of cost/performance.

No skilled microprogrammer with no exposure to the IBM 3830 control unit in its specific implementation could have arrived at the same degree of conformity or similarity to the IBM product as did the TDAS 6830 control unit. The control unit designd adopted by TDAS for the Telex 6830 disk file control unit was only one of enumerable design choices which could have been selected to achieve this same function. It would not have been possible for Telex to incorporate the precise technical designs previously incorporated in the 3830 without coyping those designs.

F159. As a result of its access to and use of IBM's trade secrets with respect to Merlin, Telex was able to develop its 6830 control unit in substantially less time and at substantially lower expense than would have been the case had it been developed independently. Telex thereby was unjustly enriched. By May 15, 1971, Telex TDAS had completed approximately 60% of the 3830 type disk controller internal processor design.

The IBM development effort required between two and three years to reach the equivalent point in the design of the 3830 control unit. In IBM a competent group of engineers with disk drive experience but no prior Merlin experience required six years to develop the Merlin. Telex scheduled the development of an equivalent Merlin system with a competent group of engineers, including selected key people with IBM Merlin experience, in only 18 months through the use of IBM's knowledge of Merlin.

The completion of the project by Telex, however, was not accomplished within this period, since Telex's Santa Clara, California, facility, established for the purpose in early 1971, was abandoned in April, 1972. The evidence does not disclose precisely what percentage of the project was then finished, but it seems fair to infer from the evidence that it was more than half completed. In IBM the approximately 6 year development effort on Merlin cost IBM over $30 million.

A group of people experienced in Merlin and developing Merlin in 18 months, or even in twice that length of time, would have a substantial amount in development cost; but the saving that could be deemed to flow from the utilization of protectable confidential information and trade secrets by Telex would not be proportional to the time involved, since Telex was entitled to utilize the general expertise and competence of its employees in view of generally developing technology, and this in any event should have substantially reduced the time required for the redevelopment of a Merlin design.

Considering the entire record, and by fair approximation, the court finds that as a proximate result of the improper utilization of IBM's trade secrets, Telex saved for itself at least $10 million in its Merlin development costs to the extent that development was completed by April of 1972, and was unjustly enriched to this amount; by this amount, on a standard of comparison basis, IBM was damaged beyond the sales price Telex received for this and other designs as hereinafter mentioned, there being no better gauge by which to measure IBM's entitlement.

F160. As above indicated the Clemens' Santa Clara group proceeded with its assigned work in design and development of a disk drive controller until April of 1972, at which time it had not been fully completed. At this date Telex abandoned the Santa Clara activity and shortly thereafter the Santa Clara facility was closed, Telex determining to purchase disk drive controllers from Itel Corporation and to market them under the Telex brand. Telex never produced or marketed a disk drive controller manufactured to the design which was in progress at Santa Clara, nor has it since done so.

On May 22, 1972, it agreed to sell, and Control Data Corporation agreed to buy, the manufacturing rights to the Telex 6830-type disk control unit, pursuant to a non-exclusive and non-assignable license agreement, together with IBM's FRIEND program source deck hereinafter mentioned for the sum of $500,000.

In addition Control Data agreed to pay Telex an additional $36,000 for prototype number 1 and number 2 of the control unit, residual supplies, and shipping, packaging and handling charges. Telex has sought to derive further benefit from the sale of others of IBM's Merlin trade secrets, and there is a reasonable probability that Telex will do so to its further unjust enrichment and to the great future damage of defendant unless enjoined by the court.

F161. "FRIEND" (Version 2) is an acronym for Fast Running Interpreter Enabling Natural Diagnostics. The source code for FRIEND competitively is extremely valuable to IBM and would be of great value to IBM's competitors. The FRIEND program is a diagnostic program used by field engineering and development engineering personnel to assist in the diagnosis, checkout and debugging of various devices in a computing system.

It permits more rapid diagnosis of malfunctions and assists in identifying errors in design. It has been used in the development of various IBM products. The program was developed at the IBM San Jose laboratory prior to 1970, one Findlay having worked nearly two years on the program and having received an outstanding contribution award from IBM for his efforts.

F162. Findlay developed FRIEND (Version 2) by writing instructions in programming language intelligible to a human reader. In this form the program is called a "source code". The source code was subsequently translated to an "object code" which is the form of the program that can be utilized by computers. While the source code of a program such as FRIEND can be translated to an object code, the object code cannot be translated to the source code.

A printout of the object code of the FRIEND 2 program is nothing more than an unintelligible mass of letters and numbers which only a computer can utilize. The source code for FRIEND, unlike the object code, can be used by development engineers to design and test new products and for other purposes. The source code for FRIEND (Version 2) has always been treated as proprietary and confidential by IBM.

Since its completion, it has been stored on a reel of magnetic tape and kept in Findlay's possession. IBM has never released it, and only the object code for this program has been made available to IBM field engineers and those outside IBM's development laboratories.

F163. Prior to leaving IBM to work for Telex, an IBM employee secured a copy of the FRIEND (Version 2) program and brought it with him to Telex. While the circumstantial evidence establishes this fact beyond question, the identity of the employee has not been determined. In the spring of 1971, Neil Glover, then an IBM employee, left IBM to begin work at Telex.

Glover and Findlay worked together in the same diagnostic programming group at the IBM San Jose laboratory. Glover in his work had access to the source code for FRIEND (Version 2). Brigitte deSaint Phalle, then an IBM employee, was hired by Telex in July of 1971. When she arrived at the TDA facility she was given a source listing and comments of FRIEND.

The source listing and comments belonged to Glover. The source listing was in the form of a computer printout. She transferred this printout to a deck of punched cards. When the TDAS facility was closed by Telex, much of the matrial from TDAS was sent to Tunisa and some of the material in punched card form was placed on magnetic tape. This work was done by John Hasty, a Telex employee.

During pre-trial discovery Telex produced to IBM a number of reels of magnetic tape. One of these reels identified as "Hasty 003" contained material from the TDAS facility and the first portion of that tape consists of a source listing of the FRIEND (Version 2) program.

The source listing of the FRIEND (Version 2) program in Telex's possession was copied from a source listing created by Findlay, as shown by irrefutable circumstantial evidence: Both listings have the same number of pages—54; each of these pages has the same format and the same number of lines; idiosynchratic notations used by Findlay and not generally used by other programmers appear in both listings; spelling errors made by Findlay appear in both listings; the only difference in the listings consists of 22 keypunch errors that appear in the Telex version and normally could have been made in copying.

Telex used the source code of FRIEND (Version 2) to help in the design of the controller under development at Telex's TDAS facility, even though the proprietary status of that program was later sold to Control Data Corporation by Telex as part of the May 22, 1972, agreement above-mantioned. The court finds that Telex deliberately misappropriated, used and sold to Control Data this FRIEND (Version 2) source code listing and comments.

F164. Prior to November, 1970, IBM initiated several secret and confidential advanced disk development programs at the IBM San Jose laboratory which were given the code names Winchester, Iceberg, Apollo and Midas. Except for certain characteristics of the Winchester program which were disclosed as part of the announcement of the disk product as the 3340 in March, 1973, the Winchester, Iceberg, Apollo and Midas development programs have been treated as secret and confidential IBM development programs by IBM, and all departing employees were reminded of this confidentiality.

F165. Beginning in early 1971, Telex began developing products intended to be equivalent to Midas, Winchester and Iceberg, based in part on IBM trade secrets and confidential information solicited and obtained by Telex from its employees who had previously been employed by IBM.

Shortly after Telex embarked upon its extensive hiring program, it revised its product calendar to include the 7330 (characterized as the "next generation 6330") which was Telex's planned copy of Iceberg and the 7312 (characterized as a "head in pack; 30 MB/cart") which was Telex's planned copy of Win-

chester. In early 1972 Telex terminated its 3330 manufacturing activity at Santa Clara.

However, Martin ordered Kevill to continue work on the "3330 spindle as a stepping stone for the Midas, Apollo, Iceberg and Winchester type product."

It is clear from numerous recruitment activities and Telex's internal communications and documents that Telex's advanced development disk program included future disk products identified as Iceberg, Midas, Winchester and Apollo, and that an important effort of Telex was to obtain not only skill per se but information concerning IBM's confidential plans and designs and that, indeed, Telex did obtain as a result of its efforts from Kevill and others confidential IBM engineering design information, confidential IBM planning information, and confidential IBM pricing information was used among other things to prepare a Midas-Iceberg cost estimate.

During August, 1972, Telex's President James was negotiating a contract with Hitachi, a Japanese manufacturer. One of the inducements Telex proposed to Hitachi was access to information relating to IBM's unannounced disk programs known to Telex employees. Telex also offered to provide Hitachi with information that would enable Hitachi to design an equivalent to the unannounced IBM Apollo.

In these and other ways, Telex has deliberately adopted a continuing policy for penetration of IBM trade secrets and confidential information on unannounced products.

F166. Telex's memory program began in 1970, on the basis of confidential IBM business information, and since then Telex has attempted to obtain additional information and trade secrets of IBM. Telex launched its memory program partly on the basis of information obtained by James from IBM confidential documents.

James' recommendations were based to a substantial extent on his knowledge of the unannounced prices and confidential forecast data relating to IBM's NS memories which he disclosed in the June 11 memorandum to Martin.

Among the material James took with him when he left IBM was information from registered IBM confidential documents, the SCAN forecast assumptions and the Plan 25 Forecast. The prices disclosed in James' June 11 memorandum for the "NS–2" CPU and its associated memory were identical with the prices contained in the IBM SCAN forecast assumptions.

The forecast of total installed NS systems on which James' projection of memory potential was based, was identical with the forecasts of NS installations contained in the IBM Plan 25 Forecast. IBM employees experienced and knowledgeable in IBM's plans and designs were sought by Telex through the offer of exceedingly liberal salaries and bonuses, in some cases as much as a quarter of a million dollars, if equivalent memories could be produced.

Telex's recruitment program in the memory field were not signally successful. While it is clear that substantial confidential information was obtained by Telex concerning the IBM memory program, the evidence is insufficient to permit the court to quantify such information. A similar situation exists with respect to Telex's attempts at misappropriating IBM's trade secrets and proprietary information regarding communications controllers.

F167. There is evidence in the record showing that Telex attempted to recruit, and in several instances did recruit, IBM employees with the intent to misappropriate IBM trade secrets and confidential information concerning IBM CPU's, and that Telex has attempted, and is now attempting, in negotiations and arrangements with Hitachi to capitalize on its ability to obtain IBM confidential information.

On November 16, 1972, Telex's representative Demmer, a former IBM employee, represented to Hitachi among other things: "The way to optimize on the benefits of having the IBM knowledge that exists in Tulsa, and also the technical resources that exist in Kanagawa, is to do the basic design of the CPU in Tulsa until such time that the specs are frozen and the first prototype has had some testing to verify this basic design." Joint development efforts are now proceeding as between Telex and Hitachi.

F168. In all of the areas above indicated, where IBM confidential and trade secret information has been sought or utilized by Telex, the line of demarcation between such use and legitimate utilization of the skills, knowledge, judgment and expertise of former IBM employees is often difficult, and on occasion impossible, to delineate with accuracy or assurance.

However, in all of the areas discussed above, it is quite clear, and the great preponderance of the evidence shows, that Telex has had the intent to benefit not only from these appropriate elements of utilization but from confidential information and trade secrets which IBM, within the awareness of Telex, has had the right to preserve; and, in the areas where the court has found that the evidence is sufficiently definite to authorize awards to IBM the court believes and finds that the preponderance of the evidence indicates that the utilization of such confidential information and trade secrets knowingly and willingly by Telex, without reference to the other areas of legitimate utilization of personnel formerly employed by IBM, proximately caused and authorized the damages found herein.

X. STATUTE OF LIMITATIONS AS TO THE MISAPPROPRIATION OF CONFIDENTIAL INFORMATION AND TRADE SECRETS

F169. Resolution of the reserved issue whether the statute of limitations has barred IBM's counterclaims against Telex primarily depends upon the conclusions of law to be set out hereinafter rather than upon facts beyond those already found. However, additional relevant facts must be determined particularly with reference to IBM's claim that Telex fraudulently concealed its utilization of confidential information and trade secrets and thus tolled whatever statutes of limitations may be held to be applicable.

F170. Howard Gruver was hired from IBM as hereinabove mentioned in July, 1970. The first IBM engineer of significance hired by Telex after that time was John Clemens, who was hired in November, 1970. IBM became concerned that if Telex hired's number of key IBM engineers and put them to work on the same project they worked on at IBM there would be risk of disclosure of its trade secrets and confidential information.

Accordingly on December 3, 1970, J. D. Kuehler, Director of IBM's San Jose laboratory, wrote to Telex President Jatras concerning Telex's hiring of Clemens. On December 11, 1970, TCP President Martin responded on behalf of Telex to Kuehler's letter to Jatras, and assured Kuehler that Telex intended to develop its own technology from Telex's own, and public, sources.

Martin also represented to Kuehler that Telex had instructed Clemens that he was not to bring with him or retain possession of any drawings, specifications or documents belonging to IBM, and that it was not Telex's policy to focus recruitment on any one employer.

Martin suggested it would be in the interest of both companies if Kuehler and he were to have a meeting to discuss the matter of recruiting, trade secrets and confidential information in more detail. During the period of time between the letter from Kuehler to Jatras and Martin's response to Kuehler, Jatras and Clemens were in fact actively recruiting IBM employees Kevill and Hancock and attempting to recruit IBM employee Wilmer.

On January 5, 1971, Kuehler wrote Martin and accepted his suggestion that a meeting be held between representatives of IBM and Telex to discuss the potential exposure that might arise from Telex's hiring of IBM engineers to develop a Telex system functionally equivalent to the system they had recently developed for IBM.

During the period of time between the Kuehler letter setting up a meeting with Martin and the actual meeting held on February 17, 1971, Telex successfully recruited Mr. Ice and Mr. Hou from IBM to work at TDAS in the development of a Telex product similar to the 3330.

F171. On February 17, 1971, Martin met with Kuehler and R. H. Mattern, Jr., of IBM at the latter's Menlo Park Laboratory. During this meeting Kuehler informed Martin that IBM was greatly concerned when a key engineer who had been in an IBM development program like the Merlin was recruited by a competitor and given an assignment of developing a product compatible to that which he had developed at IBM under the incentive of a performance bonus for meeting extremely tight time schedules.

Kuehler stated that such action could deter "independent contributions" and expose individuals to the necessity of using IBM trade secrets and proprietary and confidential information to realize the bonus.

Martin informed Kuehler that Telex had recently changed its policy concerning bonuses with regard to performance based on schedules and that Telex with one exception was now using more conventional salary and stock option plans. Martin further told Kuehler that he did not want key former IBM engineers to use IBM's confidential information at Telex and that he had asked

engineers when they joined Telex to sign an agreement that they would not bring Telex any documents or drawings of a confidential nature.

Martin assured Kuehler among other things that he would make certain none of the engineers recreated IBM trade secrets or confidential IBM information from memory once they joined Telex. He also indicated that he believed that the percentage of IBM employees with Telex was already too high and that he didn't intend to recruit any more employees from IBM. Kuehler left this meeting with the impression that Martin would follow through with the things he had said.

F172. Contrary to Martin's representation, in April, 1971, Telex hired Neil Glover from IBM, and in September, 1971, Telex recruited and hired Dick Charlton, who was a key mechanical engineer working on Merlin. It was not until the summer of 1971 that Kuehler heard reports that, contrary to Martin's representation, Telex salesmen were telling customers that they planned to deliver a Merlin type subsystem by the first quarter of 1972.

At the time said representations were made by Martin, and continuing thereafter, Telex intended to attempt to recruit and hire and in fact did thereafter hire key IBM personnel by offering them large bonuses and stock options, and intended to utilize and in fact did continue to utilize IBM trade secrets and confidential information in conducting Telex business.

F173. Key IBM engineering personnel upon leaving IBM acknowledged that they had had access to IBM trade secrets and proprietary and confidential information during their IBM employment and agreed not to divulge such information despite having prior knowledge that the respective positions they had accepted at Telex required the use of such information to a greater or less degree.

All IBM employees signed a Confidental Information and Inventions Agreement upon being employed by IBM. Among those so signing were Clemens, Charlton, Glover, Hancock, Hou, Ice, Kevill, and Wilson. By signing such an agreement an IBM employee bound himself not to disclose to anyone outside of IBM or use in other than IBM's business any confidental information relating to IBM's business either during or after his IBM employment.

When a key employee left IBM to join one of its competitors his manager, and usually a patent attorney, conducted an exit interview during which an attempt was made to define the types of trade secrets and confidential and proprietary information the employee had received. That information was documented and during the exit interview reviewed.

The employee was told he was free to make any change he desired, after which the information was recorded in a letter to the employee in confirmation of his responsibility of secrecy. Among the recipients of such letters were Charlton, Clemens, Glover, Hancock, and Kevill.

F174. Telex's President James upon terminating employment at IBM to join Telex concealed the fact Telex hired him at least in part to obtain proprietary IBM information and that he knew he would have to use such information to perform his duties at Telex. When James terminated his employment at IBM in March of 1970, IBM was left with the impression that he was solicited for his overall accounting experience and not for any particular proprietary data of which he might be possessed.

As part of his termination interview James signed a statement referring to his previous agreement with IBM not to disclose to anyone outside of IBM, or use in other than IBM's business, confidental or proprietary information after his IBM employment without IBM's written permission. IBM under all the circumstances had no reasonable notice or knowledge of the existence of the facts on which the counterclaim is based until within two years of the filing of such counterclaim.

XI. IBM'S FURTHER EFFORTS TO PROTECT ITS TRADE SECRETS

F175. During and following the year 1970, IBM has had significant security measures in place to protect its trade secrets and design information, including magnetic locks on building doors to allow access only to authorized personnel, procedure to control the distribution and use of documents containing IBM trade secrets or confidential information, designated "Registered IBM Confidential Documents", and signed agreements by which employees undertake not to disclose such information, as well as exit interviews reaffirming the responsibilities of the employee.

In the early 1970's it learned that some trade secrets and confidential information, including parts, specifications, drawings and processes, were being stolen by

persons other than plaintiffs, and beginning in the latter part of 1970 IBM significantly increased its security measures, including those pertaining to documents, to hardware manufactured within IBM, and to its hardware manufactured outside of IBM.

F176. IBM has been impelled to expend more money on additional security measures by reason of increasing violation of its trade secrets and confidential information by Telex. IBM's System Development Division is spending $2 million a year more than in 1969–1970 on increased security measures.

At the IBM San Jose laboratory direct expenditures on increased security precautions such as guards, television cameras, sensors, locks, safes, computer controlled access system, and the like, implemented since November, 1970, have been in the neighborhood of $1 million.

The necessity of manufacturing specialized and sensitive parts in view of threats to its security rather than to contract them with an outside vendor has raised IBM's production costs: its additional cost in manufacturing within IBM the Merlin head arm for security reasons has been more than $400,000. The efficiency, essential intercompany communication and morale of IBM's engineering staff have suffered by reason of the more stringent security measures.

F177. Reasonable efforts and precautions to protect trade secrets and confidential information are to be expected on the part of those entitled to their benefit. The expenses of reasonable protection should not be shifted to competitors whose mere existence motivates such protection.

But where efforts of a competitor to unlawfully penetrate trade secrets occasion extraordinary measures for their protection, it is not unreasonable for them to be borne by the party so unlawfully occasioning them.

The evidence renders it difficult, if not impossible, to determine what parts of the increased cost inaugurated in 1970 by IBM in protecting its trade secret and confidential information was ordinarily expectable expense or occasioned by persons other than plaintiffs, and what part was extraordinary expense rendered necessary by plaintiff's unlawful activities.

The allocation of Telex's fair share of responsibility, again, rests at best upon a judgment of fair approximation in view of all of the circumstances, upon which basis the court finds the fair, non-speculative, minimum amount would be approximately $3 million for increased extraordinary security costs reasonably occasioned by Telex's unlawful activities during 1971 and 1972, together with $400,000 for extra manufacturing costs.

F177–1. The conduct found herein on the part of plaintiffs in violation of defendant's confidential information and trade secrets was planned, deliberate and willful, reasonably justifying the award of punitive damages in the amount of $1 million.

XII. TELEX COPYING OF IBM COPYRIGHTED MANUALS

F178. In connection with the marketing of IBM's Aspen tape product, IBM prepared, printed, published and distributed a manual entitled "Systems Component Description—IBM 3803/3420 Magnetic Tape Subsystems". The purpose of such manual was to provide a general introduction to the Aspen magnetic tape subsystem for IBM's customers. IBM has a valid copyright covering said manual. Telex has copied this IBM manual. Telex prior to June, 1971, had in its possession and control a copy, or copies, of this manual. In connection with the marketing of its replacement copy of IBM's Aspen tape subsystem, Telex on or about June, 1971, and thereafter, prepared, printed, published and distributed its manual entitled "Systems Component Description—Telex 6803/6420 Magnetic Tape Subsystems". The purpose of such manual was to provide a general introduction to the Telex replacement copy of the Aspen tape subsystem for Telex's customers. This publication was copied substantially in whole from the said IBM manual. Telex has shipped approximately 690 6803/6420 tape subsystems through December, 1972, accompanied by said infringing manual.

F179. Telex has infringed IBM's copyright in the manual "IBM Field Engineering Theory of Operations—2314 Direct Access Storage Model 1 and A series, 2844 Auxiliaries Storage Control" four times by copying portions of it in its following four manuals "Model 730 Storage Control Unit, Volume 1—Operation and Service", "Model 728 Storage Control Unit, Functional Description", "Model 728 Storage Control Unit, Volume 1—Operation and Service", and "Model 728 Storage Control Unit Logic Diagrams—Volume 2". In connection with providing maintenance services for its 2314 disk product, IBM prepared,

printed, published and distributed a manual entitled "IBM Field Engineering Theory of Operation—2314 Direct Access Storage Facility, Model 1 and A series, 2844 Auxiliary Storage Control". The purpose of the IBM Manual is to provide an understanding of the theory of operation of the equipment to facilitate its maintenance, preventive maintenance and operation. IBM has a valid copyright covering said IBM Manual. Telex has distributed a manual entitled "Model 730 Storage Control Unit, Volume 1—Operation and Service". Telex has distributed a manual entitled "Model 728 Storage Control Unit, Functional Description". Telex has distributed a manual entitled "Model 728 Storage Control Unit, Volume 1—Operation and Service". Telex has distributed a manual entitled "Model 728 Storage Control Unit Logic Diagrams—Volume 2". The purpose of said manuals so distributed by Telex is to facilitate maintenance, preventive maintenance and operation of the Telex 5314 version of the IBM 2314 disk subsystem. Telex has exclusive marketing rights to the 5314. Telex's marketing of the 5314 includes providing service to its customers, and Telex in fact provides such service. Portions of said manuals so distributed by Telex are substantially similar to, or identical with said IBM Manual. Telex has shipped approximately 453 728 Storage Control Units and approximately 24 730 Storage Control Units through December, 1972, accompanied by infringing manuals.

F180. Telex has infringed IBM's copyright in the manual "IBM Field Engineering Theory—Maintenance Magnetic Tape Units 2420 Model 7", three times, by copying portions of it in the following three Telex manuals "5420 Mod 7 Maintenance Manual", 6420 Magnetic Tape Drive Maintenance Manual", "5420 Mod 5 and 7—Theory of Operation". In connection with the maintenance of its 2420. Model 7 magnetic tape drive, IBM prepared, printed, published and distributed an IBM manual entitled "IBM Field Engineering Theory—Maintenance Magnetic Tape Units 2420 Model 7". The purpose of said IBM Manual is to provide an understanding of the theory of operation of the equipment to facilitate maintenance, preventive maintenance and operation of the equipment. IBM has a valid copyright covering said IBM Manual. Telex has copied said IBM Manual. Telex prior to April, 1971, had in its possession and control a copy, or copies, of the IBM manual entitled IBM Field Engineering Theory—Maintenance Magnetic Tape Units 2420 Model 7". In connection with the maintenance of its replacement version of the IBM 2420 tape drives, Telex, in or about April 1971, prepared, printed, published and distributed a Telex manual entitled "5420 Mod 5 and 7 Maintenance Manual". In connection with the maintenance of its replacement version of the IBM 3420 tape drive, Telex in or about November, 1971, and thereafter, prepared, printed, published and distributed the Telex manual entitled "6420 Magnetic Tape Drive Maintenance Manual". In connection with the maintenance of its replacement version of the IBM 2420 tape drive, Telex printed, published and distributed the manual entitled "5420 Mod 5 and 7—Theory of Operation".

The purpose of these manuals is to facilitate repair, preventive maintenance and operation of the 5420, Telex's replacement version of the IBM 2420 tape drive. Portions of Telex's said Manuals were substantially similar to, or identical with, said IBM Manual. Telex has shipped approximately 933 5420 tape drives and approximately 2,006 6420 tape drives through December, 1972, accompanied by infringing manuals.

F181. Telex has infringed IBM's copyright in the manual "IBM Field Engineering Theory—Maintenance Magnetic Tape Units, 2420 Model 5, 2420 Model 7", twice by copying portions of it in two Telex manuals "5420 Mod 5 and 7 Maintenance Manual" and "6420 Magnetic Tape Drive Maintenance Manual". In connection with the maintenance of its 2420 tape drives, IBM prepared, printed, published and distributed a manual entitled "IBM Field Engineering Theory—Maintenance Magnetic Tape Units, 2420 Model 5, 2420 Model 7". The purpose of said IBM Manual is to provide an understanding of the theory of operation of the equipment to facilitate repair, preventive maintenance and operation of the equipment. IBM has a valid copyright covering said Manual. Telex has copied said IBM Manual. In connection with the maintenance of its replacement version of the IBM 2420 tape product, Telex, in or about April, 1971, prepared, printed, published and distributed a Telex manual entitled "5420 Mod 5 and 7 Maintenance Manual". In connection with the maintenance of its replacement version of the IBM 2420 tape product, Telex in or about November, 1971, and thereafter prepared, printed, published and distributed the Telex manual entitled "6420 Magnetic Tape Drive Maintenance Manual". The purpose of these Telex manuals is to facilitate repair, preventive maintenance and opera-

tion of the 5420, Telex's replacement copy of the IBM 2420 tape drive and the 6420, Telex's replacement copy of the IBM 3420 tape drive. Portions of Telex's said Manuals are substantially similar to, or identical with, IBM Manual DX 1720, Telex has shipped approximately 933 5420 tape drives and 2,006 6420 tape drives through December, 1972, accompanied by infringing manuals.

F182. Telex has infringed IBM's copyright in the manual "IBM Field Engineering Theory of Operation Tape Controls—2803 Model 1; 2803 Model 2; 2803 Model 1 and 2", three times, by copying portions of it in the following three Telex manuals, "6803–1 Tape Control Unit Maintenance Manual", "6803–2/3 Tape Control Unit Maintenance Manual", and "Printer System, Tape Adapter Unit". In connection with the maintenance of its 2803 magnetic tape controller, IBM prepared, printed, published and distributed a manual entitled "IBM Field Engineering Theory of Operation Tape Controls—2803 Model 1; 2803 Model 2; 2803 Model 1 and 2". The purpose of the said Manual is to provide an understanding of the theory of operation of the equipment to facilitate its repair, preventive maintenance and operations. IBM has a valid copyright covering said IBM Manual. Telex has copied said IBM Manual. In connection with the maintenance of its replacement version of the IBM 3803 tape controller, in or about November, 1971, Telex printed, published and distributed a manual entitled "6803–1 Tape Control Unit Maintenance Manual". In connection with the maintenance of its replacement version of the IBM 3803 tape controller, in or about January, 1972, Telex printed, published and distributed the manual entitled "6803–2/3 Tape Control Unit Maintenance Manual". In connection with the maintenance of its 5822 tape adapter unit, on or about August 6, 1971, Telex printed, published and distributed a manual entitled "Printer System, Tape Adapter Unit". The purpose of these Telex manuals was to facilitate the repair, preventive maintenance and operation of the 6803, Telex's replacement version of IBM's 3803 magnetic tape controller, and the repair, preventive maintenance and operation of Telex's 5822 tape adapter unit. Portions of said Telex Manuals are substantially similar to, or identical with, said IBM Manual. Telex has shipped approximately 12 tape adapter units and approximately 690 6803 tape controllers through December, 1972, accompanied by infringing manuals.

F183. Telex has infringed IBM's copyright in the manual "IBM System/360. Disk and Tape Operating System, Assembler Language", by copying portions of it in Telex Manual "Functional Specifications for the Processors Subprogram of the APS Compiler". In connection with marketing its System/360 computer systems, IBM prepared, printed, published and distributed a manual entitled "IBM System/360, Disk and Tape Operating System, Assembler Language". The purpose of this IBM Manual was to provide reference information for customer's employees who were writing programs for System/360. IBM has a valid copyright covering said IBM Manual. Telex has prepared a document entitled "Functional Specifications for the Processors Subprogram of the APS Compiler" portions of which are substantially similar to, or identical with said Manual. IBM has proved no damages with reference to the last mentioned document.

F184. In each of the foregoing instances in which valid copyrights have been found to exist, the corresponding manual contained a notice of copyright in due form and substance and the register of copyright issued a valid certificate of registration complete and regular in form and substance. In each instance where it had been held above that portions of Telex manuals are substantially similar to or identical with the copy-righted manuals, such portions were substantial rather than trivial or *de minimis* and constituted substantial infringements with reference to material of a nature to be entitled to copyright protection, and the infringements related to both the form and substance of the writings so copyrighted rather than to the mere ideas expressed therein.

F185. Certain of the Telex manuals above-mentioned relate to the Itel/ISS—made 5314 disk drive subsystem and on their face purport to be Itel/ISS publications. Assuming that the actual copying was done by Itel/ISS, that fact would not immunize Telex against the claim of infringement under the circumstances of this case, since these manuals were used to facilitate maintenance, preventive maintenance and operation of the Telex 5314. The evidence shows that Telex has the exclusive marketing rights for the 5314 and provides services as a part of its marketing of that device.

F186. Prior to its filing of the counterclaim herein, IBM did not give Telex specific notice of copyright infringement or request Telex to discontinue distributing its manuals mentioned, although in the course of discovery in these actions IBM informed Telex that it intended to file counterclaims including those for copyright infringement.

F187. Except as hereinabove specifically found, the court has determined that the other counterclaims filed by IBM for copyright infringement have been abandoned and that no damages or other relief can be based thereon.

From the foregoing Findings of Fact the court now makes the following:

Conclusions of Law; Discussion

A. Jurisdiction and venue

Conclusion 1. The court has jurisdiction of plaintiffs' claims of violations of Sections 1 and 2 of the Sherman Act, 15 U.S.C. §§ 1 and 2, and Section 3 of the Clayton Act, 15 U.S.C. § 14, by reason of 15 U.S.C. § 15. The court has jurisdiction of the defendant's counterclaims for violations of its trade secrets and confidential information, unfair competition and copyright infringement by reason of the diversity of citizenship between the parties within the contemplation of 28 U.S.C. § 1332, and pursuant to 28 U.S.C. § 1338 concerning copyrights and unfair competition. The court also has jurisdiction over the persons of all of the parties. Venue of this action is properly laid in the Northern District of Oklahoma by reason of 15 U.S.C. § 22 and the defendant's transaction of business there.

C2. The defendant concedes, and the court finds and concludes, that the commerce involved herein is interstate commerce and that the commerce requirements of Section 1 and 2 of the Sherman Act and Section 3 of the Clayton Act have been satisfied.

B. Antitrust claims—Monopolization

C3. In applying antitrust laws, especially to new or novel situations of the nature presented here, courts should be especially sensitive to their broad policy, mindful of economic realities in the marketplace, hospitable to healthy economic practices and developments, inhospitable toward subterfuge and pretense, and practical, as well as vigilant, in avoiding control by mere custom, form, appearance or contrivance. Fair and reasonable business practice should be the watchword, predatory conduct a red flag, considerate judgment the measure, and free and unfettered competition in the spirit of Northern Pac. R. Co. v. United States, 356 U.S. 1, 4 (1958), the large objective:

"The Sherman Act was designed to be a comprehensive charter of economic liberty aimed at preserving free and unfettered competition as the rule of trade. It rests on the premise that the unrestrained interaction of competitive forces will yield the best allocation of our economic resources, the lowest prices, the highest quality and the greatest material progress, while at the same time providing an environment conducive to the preservation of our democratic political and social institutions."

C4. As extensive and detailed as it has been deemed necessary to make the foregoing findings for disposition of the case and an understanding of that disposition, and in a sense because of them, it does not appear necessary to document the bases of my conclusions with similar detail, in view of my belief that they rest upon basic antitrust principles that hardly require extension to meet the peculiar circumstances. Nonetheless, related legal problems are numerous and significant; and an effort will be made to indicate the rationale of any such adaptations and to notice some of the rejected contentions of one party or the other that have seemed most persuasive on their face, though indeterminative.

C5. Defendant says that "to maintain an action under Section 2 of the Sherman Act, plaintiffs bear the burden of establishing, *inter alia*, that there exists some relevant market in which IBM has unlawfully acquired monopoly power—the power to exclude competition and control prices", citing *e.g.*, Walker, Inc. v. Food Machinery, 382 U.S. 172, 177–8 (1965); American Tobacco Co. v. United States, 328 U.S. 781, 785 (1946); and United States v. E. I. Du Pont De Nemours & Co., 118 F. Supp. 41 (D. Del. 1953), *aff'd*, 351 U.S. 377 (1956). Plaintiffs' burden of proof is not subject to question, but the unlawful acquisition of monopoly power is not a *sine qua non* for liability if a lawfully acquired monopoly be unlawfully maintained or attempted. *Walker* was in a limited patent context. *American Tobacco* accepts monopoly intent as being controlling. I find nothing to the contrary in *Du Pont* which through its patent context and the interchangeability rule really found it unnecessary to treat a situation where a lawfully acquired monopoly is unlawfully maintained with requisite intent. In the context of the present case I subscribe in large part to the statement contained in National Screen Service Corp. v. Poster Exchange, Inc., 305 F.2d 647, 651 (5th Cir. 1962) (see also Poster Exchange, Inc. v. National Screen Service Corp., 362 F.2d 571 (5th Cir.), *cert. denied*, 385 U.S. 948 (1966):

"Every illegal monopoly is condemned regardless of the circumstances which brought it into existence. The law does not condition its condemnation upon a history of misconduct or baleful practices. Indeed, a position of illegal monopoly may be achieved by enterprise and sagacity [citing Associated Press et al. v. United States, 326 U.S. 1, 65 S.Ct. 1416, 89 L.Ed. 2013 and United States v. Klearflax Linen Looms, Inc., 63 F. Supp. 32 (D. Minn. 1945).] The symptoms are not always the same. In its common forms, price fixing, price leadership, and exclusion of competitors from the market are criteria of illegality under the act. In any case the real question is whether there is an illegal monopoly. Gamco, Inc. v. Providence Fruit & Produce Building, 1 Cir., 194 F.2d 484. In practically all cases where a course of conduct is under inquiry, the universal test seems to be whether there is 'any purpose to create or maintain a monopoly.' Lorain Journal Co. v. United States, 342 U.S. 143, S.Ct. 181, 96 L.Ed. 162 (1953); United States v. Colgate Co., 250 U.S. 300, 39 S.Ct. 465, 63 L.Ed. 992, 7 A.L.R. 433 (1919) . . . Ultimately, the courts must decide under the facts in each case the point at which freedom to trade must give way to control under § 2 of the Sherman Act. An individual's freedom to trade in the market is unqualified so long as a monopoly is not sought or enjoyed."

C6. I believe the applicable rule to be that monopolization in violation of Section 2 of the Sherman Act involves two elements: (1) The possession of monopoly power in the relevant market or submarket and (2) the willful acquisition or maintenance of that power with intent to monopolize, which intent need not be evidenced by predatory practices but which is not to be gathered merely from growth or development as a consequence of a superior product, business acumen or historic accident. See United States v. Grinnell Corp., 384 U.S. 563 (1966); United States v. Aluminum Co. of America, 148 F.2d 416 (2d Cir. 1945) (sitting for the United States Supreme Court by certification); Hanover Shoe v. United Shoe Mach., 392 U.S. 481 (1968) (expressly approving Judge L. Hand's opinion in United States v. Aluminum Company of America, *supra*). *Cf.* International Boxing Club v. United States, 358 U.S. 242 (1959).

C7. Monopoly power is the power to control prices or to unreasonably restrict competition. United States v. Grinnell Corp., 384 U.S. 563 (1966), *supra*; United States v. E. I. Du Pont De Nemours & Co., 351 U.S. 377 (1956), *supra;* American Tobacco Co. v. United States, 328 U.S. 781 (1946), *supra*. Determination of a relevant market, from both geographic and product standpoints, is essential to a finding of unlawful monopolization because an assessment of monopoly power is dependent upon such determination. United States v. Grinnell Corp., 384 U.S. 563 (1966), *supra;* United States v. E. I. Du Pont De Nemours & Co., 351 U.S. 377 (1956), *supra;* United States v. Columbia Steel Co., 334 U.S. 495 (1948); Reynolds Metals Company v. F.T.C., 309 F. 2d 223 (D.C. Cir. 1962).

C8. A relevant geographic market is the territorial area in which businessmen effectively compete. Competition in the sale or lease of peripheral products plug compatible with IBM CPU's, as well as that in the electronic data processing industry in general, is conducted on a national level by both IBM and its competitors. It is understood that neither side questions this conclusion irrespective of the EDP market or submarket to be defined.

C9. Plaintiffs say that the criteria for determining the boundaries of a relevant product market for purposes of assessing monoply power under Section 2 of the Sherman Act are the same as those for fixing boundaries of a relevant product market for purposes of Section 7 of the Clayton Act, citing United States v. Grinnell Corp., 384 U.S. 563 (1966), *supra;* Case-Swayne Co. v. Sunkist Growers, Inc., 369 F. 2d 449, *rev'd on other grounds*, 389 U.S. 384, see also 355 F. Supp. 408; Twin City Sportservice, Inc. v. Charles O. Finley & Co., 72 Trade Cases ¶ 74,150 (N.D. Cal. 1972); Credit Bureau Reports, Inc. v. Inc. v. Retail Credit Company, 72 Trade Cases ¶ 73,813 (S.D. Tex. 1971); Marnell v. United Parcel Service of America, 71 Trade Cases ¶ 73,761 (N.D. Cal. 1971); Rea v. Ford Motor Company, 337 F. Supp. 950 (W.D. Pa. 1972). The latter case seems to have no bearing upon the point, but the others cited are persuasive that as indicated in *Grinnell* there is "no reason to differentiate between 'line' of commerce in the context of the Clayton Act and 'part' of commerce for purposes of the Sherman Act." The defendant does not directly challenge this conclusion but has sought to soften the force here of some relevant market cases by emphasizing that they involve Section 7 of the Clayton Act, not Section 2 of the Sherman Act. On the other hand, as hereinafter pointed out, it has cited various Section 7 cases to support its argument of "supply substitutability" as an element in relevant market definition for the purposes of the Sherman Act.

In my opinion, while there may be possible differentiation between a "part of commerce" and a "line of commerce" in the solution of some problems that might arise under the respective acts, no practical distinction would be justified in the context of the present case. Here, as the Supreme Court has done elsewhere, we may look for guidance to each line of cases. Nor need we decide, as suggested by Mr. Justice Clark in the Section 2 case of Marnell v. United Parcel Service of America, *supra*, that the reasonable interchangeability rule of United States v. E. I. Du Pont De Nemours & Co., *supra*, has been refined and modified by the Supreme Court in subsequent Section 7 cases. Whether accepted as modifications or as mere refinements or applications to different states of fact, subsequent decisions of the court must be looked to in the light of the principles of *Du Pont* in determining the present issues. Our task is aided by the more recent cases which explore the new terrain of differing facts which *Du Pont* pointed to without assuming to decide:

"The varying circumstances of each case determine the result. In considering what is the relevant market for determining the control of price or competition, no more definite rule can be declared than that commodities reasonably interchangeable by consumers for the same purposes make up that 'part of the trade or commerce,' monopolization of which may be illegal." (351 U.S. at 395.)

As if to warn against the freezing of applications, the following comment is added in *Du Pont* by its footnote 22 from Maple Flooring Ass'n. v. United States, 268 U.S. 563, 579:

"It should be said at the outset, that in considering the application of the rule of decision in these cases to the situation presented by his record, it should be remembered that this court has often announced that each case arising under the Sherman Act must be determined upon the particular facts disclosed by the record, and that the opinions in these cases must be read in the light of their facts and of a clear recognition of the essential differences in the facts of these cases, and in the facts of any new case to which the rule of earlier decisions is to be applied."

C10. The more recent cases teach in new applications of old principles that the term "reasonable interchangeability" should be given a practical application in view of conditions in the marketplace and that while with respect to outer markets a somewhat broad leeway for interchangeability may be indulged, recognition of submarkets within broad markets may be recognized in view of competitive realities, where a lower degree of differentiation may suffice. Brown Shoe Co. v. United States, 370 U.S. 294 (1962), *supra;* United States v. Grinnell Corp., 384 U.S. 563 (1966), *supra;* Reynolds Metals Company v. F.T.C., 309 F.2d 223 (D.C. Cir. 1962); *supra;* Case-Swayne Co. v. Sunkist Growers, Inc., 369 F.2d 449 (9th Cir.), *rev'd on other grounds*, 389 U.S. 384 (1967); see also 355 F. Supp. 408 (C.D.Cal. 1971), *supra;* Power Replacement Corporation v. Air Preheater Co., Inc., 356 F. Supp. 872 (E.D. Pa. 1973); Marnell v. United Parcel Service of America, 71 Trade Cases ¶ 73,761 (N.D. Cal. 1971); Credit Bureau Reports, Inc. v. Retail Credit Co., 358 F. Supp., 780 (S.D. Tex. 1971), *aff'd*, 476 F.2d 989 (5th Cir. 1973). See Southern Blowpipe & Roofing Co. v. Chattanooga Gas Co., 360 F.2d 79 (6th Cir. 1966); Twin City Sportservice, Inc. v. Charles O. Finley & Co., 72 Trade Cases ¶ 74,150 (N.D. Cal. 1972); United States v. Aluminum Co. of America, 148 F.2d 416 (2d Cir. 1945), *supra*. See also United States v. Paramount Pictures, 334 U.S. 131, (1948).

Thus, it has been variously held that in fixing relevant product market boundaries there may be differentiations between virgin ingot and secondary ingot; first run motion pictures and subsequent run motion pictures; promotion of championship fights and the promotion of non-championship fights; accredited central station protection services and non-accredited central station protection services, local alarm systems and other onsight protection services; replacement elements for air preheaters and the air preheaters themselves; gas ranges and electrical ranges; major league baseball concessions and concession services for other large spectator sporting events, including professional football, basketball or horse racing; regularly scheduled and consolidated retail delivery service and all other forms of delivery services for retail establishments; and non-local credit reporting, life and health insurance reporting, fire and casualty insurance reporting and personal reporting. Even products that are physically identical or fungible are not necessarily to be grouped in the same relevant product market if, in fact, they are marketed to different classes of customers and are separately treated as of different commercial value by end-users. Reynolds Metals Co. v. F.T.C., 309 F.2d 223 (D.C. Cir. 1962), *supra;* (decorative foil and florist foil).

Inquiry should focus on the practical business realities of the marketplace and not on mere economic theory. Brown Shoe Co. v. United States, *supra*. "A meaningful definition for the relevant market must focus on what the buyers do and not upon what the sellers do, or theoretically can do." Credit Bureau Reports, Inc. v. Retail Credit Co., *supra*.

C11. The defendant has sought to bolster its position with reference to demand or use exchangeability or elasticity with the argument of "supply substitutability"; indeed, its economic expert placed prime reliance upon such a theory. Defendant argues that "supply substitutability between two products exists where the producer of one product can within a reasonable period of time devote his resources to production of the other product" and that "where such a condition exists, a producer has no power to exclude competition and its power over the price of its product is limited by those alternative sources of supply." It cites United States v. Columbia Steel Co., 334 U.S. 495 at 510–11; FTC v. Proctor & Gamble Co., 386 U.S. 568, 580–1 (1967); United States v. Penn-Olin Co., 378 U.S. 158, 174 (1964), and United States v. El Paso Gas Co., 376 U.S. 651, 658–9 (1964), and could well have added along the same line the late case of United States v. Falstaff Brewing Corp., 410 U.S. 526 (Feb. 28, 1973). The latter case cites most of the authorities now relied upon by defendant, but renders it clear that what is there being talked about is not the Section 2 concept of exchangeability or substitutability but the effect of a potential competitor upon "the edge of the market" in negating the desirability of its merger in a Section 7 case. This is a much more diffused inquiry than the one with which we are concerned although the two are related.

In United States v. Penn-Olin Co., 378 U.S. 158 (1964), *supra*, a joint venture was attacked by the government as being in violation of Section 7 of the Clayton Act. The distinction between these kinds of cases and the present one well appears from the court's emphasis upon the critical circumstance that in Section 7 cases it must be concerned not only with whether companies would probably have entered the market but also whether the joint venture eliminated the potential competition of a company that might have stayed on the edge of the market threatening to enter it. It is plain that United States v. Columbia Steel, 334 U.S. 495 (1948), *supra*, another Section 7 case, is also essentially different. Here we are not concerned per se with mere risks or probabilities that others might enter a market but what effect this and other circumstances actually had upon competition at a given time as a matter of reality in the marketplace. To argue broadly, as does the defendant that, since the same general technology is involved in all EDP products and all manufacturers are capable in time and with sufficient inducement to enter every part of the market, there can be no submarkets is glorifying a theory of supply substantially beyond reality. It as well could be said that in any part of commerce there can be no geographical limits to a market because manufacturers outside of it, although not actually competitors in the limited market, theoretically could enter it if the inducement were high enough. The next step of apparent logic would be to say that there could be no monopolization of any market because theoretically if an alleged monopolist raised prices high enough other manufacturers would retool, or come in from distant areas, and restore competition in response to increased inducements. We cannot accept this contention of IBM in its full breadth, but supply substitutability must be and has been recognized to the extent that it has been shown by the evidence to have influenced actual competitive conditions in any market.

C12. No proper application of the criteria of substitutability, exchangeability, or elasticity, supports the defendant's position that we are concerned with only a single relevant market consisting of "electronic data processing services and equipment." Moreover, such a general classification in the realities of the marketplace and on the record before this court would be designed to render Section 2 of the Sherman Act relatively innocuous and ineffective and would permit the defendant with impunity to continue to monopolize and attempt to monopolize a relevant market and submarkets one by one by unilateral predatory action until the entire industry could be irreparably demoralized. It would be a gross, sweeping and invalid generalization to say, as IBM contends, that it "is engaged in the manufacture, sale and lease of data processing systems and that such economic power as it may have is determined by all the competitive factors affecting the market of such systems . . . because of the variety of equipment and services which may be used to serve a particular data processing function and the variety of functions which said services and equipment can serve . . .", and "because the various devices which comprise a data processing system are to a

large degree built from common electronic and electro-mechanical components and can be manufactured by application of an essentially common technology and production facilities."

C13. Having determined on the facts that the relevant market for the purposes of this case cannot be reasonably considered to be the EDP, CPU or general systems markets in general, and that the EDP peripheral market as a whole is not an economic entity or market within which real, measurable or meaningful competition exists, the legal basis for tying a market concept to the products of a single manufacturer merits further discussion. Every manufacturer, of course, is the sole producer of its own particular product or product line and certainly not every manufacturer has an illegal monopoly with regard to the product or product line that it manufactures. But a manufacturer's product or product line may constitute a relevant product market for the purpose of Section 2 if in the realities of the marketplace widespread competition has been developed around it as a separate economic entity recognized and acted upon by the manufacturer, competitors, and end-users as such. United States v. Aluminum Co. of America 148 F. 2d 416 (2d Cir. 1945), *supra*, (sole domestic producer of virgin aluminum), see Deterjet Corp. v. United Aircraft Corp., 211 F. Supp. 348 (D.C. Del. 1962) (sole domestic producer of a hydromatic propellor system); United States v. Klearflax Linen Looms, Inc., 63 F. Supp. 32 (D. Minn. 1945) (sole domestic producer of linen rug materials). And components of a manufacturer's product or product system and their direct competition may constitute a relevant product market. Calnetics Corporation v. Volkswagen of America, Inc., 348 F. Supp. 606 (C.D. Cal. 1972); Power Replacements Corp. v. Air Preheater Co., Inc., 356 F. Supp. 872 (E.D. Pa. 1973); Deterjet Corp. v. United Aircraft Corp., *supra*. To treat defendant's peripheral products as immune from separate market consideration in view of the competition focused upon them would recognize an immunity in favor of IBM from the operation of the antitrust laws akin to that it unsuccessfully sought in a tying framework, since here also, as will be presently noted, it has avoided the proscription of Section 3 of the Clayton Act in predatory action equally anti-competitive. See International Business Machines Corp. v. United States, 298 U.S. 131 (1936).

C14. Having determined that the relevant market for appraising IBM's market power in this case is the market for peripheral EDP products plug compatible to IBM CPU's or their channels, it is now necessary to determine whether the plug compatible peripheral EDP market can or should be subdivided in appraising IBM's market power. Applying criteria gathered from the cases cited in light of *Grinnell* and *Brown Shoe*, it is concluded that the sale and lease of disk, tape, printer, memory and communication controller type peripheral products that are plug compatible with IBM central processing units are separate and distinct relevant submarkets forming parts of the plug compatible peripheral EDP market and within which IBM's market power must be appraised. In these markets I have found that while the business of leasing companies involving the separate lease or sale of such plug compatible peripherals should be included, the systems business of leasing companies should not be. This is a correlation of the finding that general systems or CPU's are not a part of the relevant market or submarkets with which we are concerned. Each of these types of plug compatible products performs a basically unique and distinct functions when utilized with an IBM CPU.

In the case of memories, disks, and tapes, the storage capacity, data rate, access time, media or lack thereof, storage of media, cost and consequent cost performance and customer utilization of each type of device is sufficiently distinct so that the distribution of each type of device constitutes a separate relevant product submarket. Particularly should this be recognized under the circumstances as shown by the record. In the sophisticated complex, and organized maintenance and attempted extension of its dominant position, IBM separately focused its market analyses and competitive responses upon and against this limited market and these several submarkets with resulting concentrated impact. It would be neither realistic nor consistent with the policy of the antitrust laws to ignore the severance and separability of these fields of competition or in more broadly defined markets to leave the dominant power free to sharpshoot at essentially separate and distinct components and to eliminate them one by one shielded, as IBM claims the right to be, by lack of control of the entire EDP market. The very contention of IBM that it should be free to launch the "competitive responses" of the predatory nature appearing here against its plug compatible competition merely because it may not have equivalent market power in the general systems market seems a confirmation of its monopolistic intent

in the narrower markets. Nor do we think it to be any valid objection to the sub-classification that it involve competition on the one hand of a single corporation; IBM's activities are as varied, extensive and significant as those of numerous other corporations combined.

C15. From its found predominant market shares, the court infers and concludes that IBM had and exercised monopoly power in the relevant market and submarkets herein defined. Circumstantial evidence apart from that relating to market share is indicative of IBM's market power in the relevant market and submarkets as they have been defined. Its own strategy, investigations, and planning were premised to an important degree upon the assumption that it had such power. The very predatory intent with which, as already has been found, its strategies were planned, as well as the nature and direction of its competitive responses, strongly suggest a consciousness of market power and a determination to utilize it to the extent that it was considered this could be done without a breach of its confidential plans or its becoming involved in legal difficulties. This is not to say that there was any ruthless or nakedly aggressive programs contemplated or carried out; anything that was done by way of strategy was sophisticated, refined, highly organized, and methodically processed and considered. But in this day and age such conduct is hardly less acceptable than the naked aggressions of yesterday's industrial powers if unlawfully directed against competition. The organized, selective, subtle sophisticated approach, indeed, may pose more danger under modern conditions than instantly more obvious strategies.

C16. The court further concludes that IBM willfully maintained its monopoly power in the relevant product market for plug compatible peripheral products and in the relevant product submarkets for plug compatible disk, tape, printer, memory and communication controller type peripheral products.

C17. The willful maintenance of a defendant's monopoly power does not require that the defendant specifically intend to monopolize—that is, to control prices or exclude competition. United States v. Grinnell Corp., *supra*. Neither the actual exclusion of competitors nor the realization of unreasonably high profits are elements essential to the offense of monopolization. United States v. Aluminum Co. of America, *supra;* American Tobacco Co. v. United States, *supra*. A specific intent to monopolize is not an essential element of the offense of monopolization. It is sufficient that monopoly power is willfully acquired or maintained as distinct from the growth or development in a consequence of a superior product, busines acumen or historic accident. United States v. Grinnell Corp., *supra;* United States v. Griffith, 334 U.S. 100 (1948); United States v. Aluminum Co. of America *supra*.

To be "willfully maintained' it is not essential that monopoly be accomplished by unreasonable restraints of trade or predatory practices. Hanover Shoe v. United Shoe Mach., *supra;* United States v. Grinnell Corp., *supra;* United States v. United Shoe Machinery Corp., 110 F. Supp. 295, *aff'd per curiam*. 347 U.S. 521 (1954); United States v. Aluminum Co. of America, *supra*. Such practices, of course, coupled with monopoly power may underscore and often characterize the offense of monopolization but it is not necessary to monopolization that market power be maintained by "maneuvers not honestly industrial". United States v. Aluminum Co. of America, *supra*. The requisite willful maintenance can result from acquisitions, United States v. Grinnell Corp., *supra*. loans Twin City Sport-service, Inc. v. Charles O. Finley & Co., *supra*, the construction of new capacity to absorb consumer demand, United States v. Aluminum Co. of America, *supra*, or discriminatory leasing arrangements in extension of patent rights, Peelers Company v. Wendt, 260 F. Supp. 193 (W.D. Wash. 1966). And the unlawful maintenance of a monopoly can be accomplished, as here, also by the maintenance or raising of prices on CPU's and lowering prices on plug compatible peripheral products against which the most threatening challenge to an existing monopoly position had arisen and through long-term leases with punitive termination provisions to cut the new order rate of plug compatible competitors for a time by almost half.

C18. Correspondingly, the court concludes that such maintenance of IBM's monopoly power in the relevant product market for plug compatible peripheral products was not the result of IBM's superior skill, foresight, or industry and was not the result of superior products, business acumen or historic accident. To an extent, it was its failure, as IBM itself recognized, to develop new technology and superior performing products as rapidly and effectively at is had hoped, and the capability of plug compatible manufacturers to keep abreast of, and in limited instances surpass, some of the technological developments that

jeopardized its monopoly position in the relevant product market, and that motivated it to undertake predatory pricing and long term leasing to stem the growth of its plug compatible competitors.

C19. Plaintiffs contend that in addition to the unlawful conduct abovementioned there were "technological obsolescence through mid-life kickers" and the "tying" of its peripheral products, including memories and control units, to its CPU's which were similarly predatory. While, as already observed, there is some evidence that actions which might be so characterized were designed to help stem the growth of its plug compatible competition, we conclude that predominant evidence demonstrates that they really represented technological advancements, a desire to make available in the market improved devices at the earliest practicable time even though other improvements were contemplated as soon as they could be developed and other legitimate efforts that cannot be fairly regarded as predatory within the contemplation of antitrust policy.

C20. Defendant points out that "the youth, growth and technological change of the electronic data processing industry render improbable the acquisition of monopoly power" and that the "quality of economic performance . . . in terms of consumer satisfaction, product innovation and price reduction is indicative of competition and not monopoly power." If it were not for the more direct and persuasive evidence to the contrary, and the fact that technological dynamics in this remarkable industry are adaptable to dynamic antitrust programs and effects also, these considerations would be persuasive. But antitrust applications and interpretations must not be inextricably tied to entrenchments of long standing when the monopolization can be accomplished in modern context and particularly in such industries as the EDP industry by fast acting strategies and sophisticated selectivity. In this sense, the dynamics of the industry and the intent of IBM may be more relevant than market shares: ". . . It is true that innovation in products in certain industrial areas where the rate of innovation—and consequently of obsolescence—is rapid, market share is essentially irrelevant to a judgment of market power. United States v. Columbia Steel Company, 334 U.S. 495 at 527–8. It is no answer to say that this industry is the youngest in which monopolization has ever been found because it might also be said that here rewards from monopolization may be among the highest and the opportunity in view of its rapid technological and market developments perhaps among the greatest.

C. Attempt to monopolize

C21. Should I be in error in the precise delineation of the relevant market and submarkets or mistaken in my view of the general systems business of leasing companies as interchangeable or elastic parts of these markets and submarkets, I am of the opinion, nonetheless, and so conclude, that attempted monopoly has been clearly made out by plaintiffs with like effect.

C22. I do not agree with plaintiffs tha tin an attempt to monopolize case it is unnecessary to establish either the relevant product market or that the attempt involves a dangerous probability of success. Little if anything is found in several of the cases cited by plaintiffs, United States v. E. I. Du Pont De Nemours & Co., *supra*, at 395 n. 23; United States v. Grinnell Corp., 236 F. Supp. 244 (D.C.R.I. 1964), *aff'd*, United States v. Grinnell Corp., 384 U.S. 563 (1966); Union Carbide and Carbon Corporation v. Nisley, 300 F.2d 561 (10th Cir. 1961); United States v. Consolidated Laundries Corporation, 291 F.2d 563 (2d Cir. 1961), *reh'g denied*, 291 F.2d 576; and Rawlins v. American Oil Co., Civil Number C–89–67 (D. Utah 1969) (appeal dismissed by reason of settlement), to support plaintiffs' view on this point. Lessig v. Tidewater Oil Company, 327 F.2d 459 (9th Cir. 1964), and Industrial Building Materials, Inc. v. Interchemical Corp., 437 F.2d 1336 (9th Cir. 1970), also cited by plaintiffs, are in point by broad expression but are not convincing in view of subsequent decisions of the Ninth Circuit, Bushie v. Stenocord Corp., 460 F.2d 116 (9th Cir. 1972); Cornwell Quality Tools Co. v. C.T.S. Co., 446 F.2d 825 (9th Cir. 1971), and for other reasons. The Tenth Circuit case of *Union Carbide* and my *American Oil* perhaps are explainable by the absence therefrom of any focus upon, or determinative importance of the point there.

C23. In any event, the great weight of current authority supports the relevant market and dangerous probability tests in attempts to monopolize cases. Walker Process Equipment, Inc. v. Food Machinery & Chemical Corp., 382 U.S. 172 (1965); American Tobacco Co. v. United States, 328 U.S. 781 (1946); Agrashell Inc. v. Hammons Products Company, 479 F.2d 269 (8th Cir. 1973); Bernard Food Industries Inc. v. Dietene Co., 415 F.2d 1279 (7th Cir. 1969), *cert. denied*, 397 U.S. 912 (1970); Central Savings and Loan Ass'n v. Federal Home Loan

Bank Board, 422 F.2d 504 (8th Cir. 1970); Hiland Dairy Inc. v. Kroger Co., 402 F.2d 968 (8th Cir. 1968), *cert. denied*, 395 U.S. 961 (1969); Kansas City Star v. United States, 240 F.2d 643 (8th Cir. 1957); Dobbins v. Kawasaki Motors Corporation, —F. Supp. —— (D. Or. No. 71–105, June 15, 1973).

C24. Mr. Baker, Director of Policy Planning for the Antitrust Division of the Department of Justice, told the American Bar Association last year:

"Monopolization is basically a structural offense and therefore relevant market and position in it are important considerations. Attempted monopoly is basically a conduct offense; and, where we are dealing with conduct which is clearly predatory and unfair, there is no public policy reason for protecting it from judicial sanction. To eliminate the 'dangerous probability' and 'market' requirements from Section 2 attempt to monopolize cases would make it a much more effective tool for dealing with indefensible single firm conduct." Vol. 5 CCH Trade Cas. ¶ 50.145 at p. 55.247.

Even the Department position does not suggest a belief that the attempt to monopolize doctrine has already become the "more effective tool" hoped for. It may well be that a complete restatement of the rule of *American Tobacco* is soon due, to reach abuses that thereby may be masked or protected in future context. But in view of the justification and authority for applying the present formalization to the present situation here I shall not assay it. Suffice it to say now that under the presently accepted rule the precise boundaries of relevant markets and the likelihood of success in and of themselves become less important in attempt to monopolize cases as aggressive predatory intent and conduct emerge more clearly. See Dobbins v. Kawasaki Motors Corporation, *supra*, and Power Replacements Corp. v. Air Preheater Co., Inc., *supra*. And the precise articulation of the rule is not as important as the idea of likelihood of monopolization if a predatory intent remains unchecked. See Kansas City Star Company v. United States, 240 F.2d 643 (8th Cir. 1957).

In one of the latest cases on the subject, Power Replacements Corp. v. Air Preheater Co., Inc., 356 F. Supp. 872 (E.D. Pa. 1973), the plaintiff alleged among other things that the defendants violated Sections 2 of the Sherman Act in connection with the sale of a replacement element in installations of air preheaters. There were no allegations of monopolistic activity in the manufacture and sale of air preheaters themselves. The defendants sold around 90% of all of the regenerative type air preheaters sold in the United States, which were the most successful type, and there was no question that they achieved this position in the market lawfully. The focal point of the case was the competition in the sale of replacement elements for use in the regenerative type of preheaters (Ljungstrom). The court held that "(t)he relevant product market to be used in testing the plaintiff's claim in its lawsuit is replacement element for use in Ljungstrom Air Preheaters".

In 1963 the defendant Air Preheater Company had a complete monopoly of the air preheater replacement business (as a result of its manufacture of the preheater itself). The high profitability of its replacement business invited competition. The users of heating elements because of defendants' high prices looked around for competitive alternatives and this was the genesis of plaintiff's business. With plaintiff's entry into the market, the defendants gave immediate attention to pricing strategy, believing that if moderate strategy did not work it was a "big enough operation so that we could beat this competition and whatever other competition might develop in other areas." The share of the market to be expected by plaintiff was predicted by defendants depending on the latter strategies. The defendants forecast of its sales of the market "was not just a prediction but the percentage it set for itself as a goal". Among other strategies defendants coded their element in vew of the previous simple description and this handicapped the plaintiff in working up a bid for potential customers. The court referred to presumption of market control flowing from command of a high percentage of the market in view of the decided cases but added:

"In the present case, while it has been established that the defendants have managed to maintain approximately 75% of the business known to them, we have not been provided with sufficient evidence to compute precise percentages as to the actual share of the market for each company during each year. This was no comfort for the defendants, however, since we had concluded that Air Preheater's power to exclude the competition of power replacements has been proven directly so that no inference from the market share percentage is necessary . . .

"It is important to note that plaintiff would have proven a violation of Section 2 even if they had not shown that success rewarded defendant's attempt to monopolize. Plaintiffs have had no difficulty in establishing that Air Preheater, while possessing a significant degree of market power, engaged in a course of conduct which was likely to achieve monopoly power, and that also Air Preheater committed certain commercially unfair acts with the specific intent to injure plaintiff and eliminate competition, thereby proving attempted monopolization. See Times Picayune Publishing Co. v. United States, 345 U.S. 594, 73 S.Ct. 872, 97 L.Ed. 1277 (1953); Lorain Journal v. United States, 342 U.S. 143, 72 S.Ct. 181, 96 L.Ed. 162 (1951)."

The court concluded that the defendants violated both Section 2 of the Sherman Act and the Robinson-Patman Act but limited damages because of the insufficiency of plaintiff's proof. The court concluded as to Section 2:

"Without restating the evidence contained in this voluminous record, the sum and substance of our findings of fact number 55 to 81 is that since the latter part of 1965 Air Preheater has willfully attempted to monopolize the replacement element market and that Air Preheater has successfully maintained that monopoly power."

C25. I find the last mentioned case singularly in point, and persuasive not only with respect to the issue of relevant markets based upon the product of a single manufacturer, but covering the effect of proof of predatory conduct on the issue of probability of monopolization. If the old "dangerous probability rule" is to be literally applied, I believe that it can be deemed satisfied by the circumstances established by the record from which sufficient market dominance, organizational capability and determination to control, can be found to render it likely to the point of danger that IBM's program, if unchecked, will maintain or achieve monopolization in the relevant market and submarkets, whether or not the business of leasing companies is included and irrespective of the precise boundaries of any reasonable relevant market or submarkets.

C26. The sum total of all evidence must be considered on the issue of predatory intent, and there is no set formula for such a finding. Continental Baking Co. v. Old Homestead Bread Co., F. 2d (10th Cir. 1973). The court is convinced that the sum total of all of the evidence establishes that IBM undertook the 2319A, 2319B, FTP and memory pricing, with specific and predatory intent of suppressing and eliminating its plug compatible competition and that such conduct taken pursuant to this anticompetitive purpose in fact suppressed and eliminated IBM's plug compatible competition to a substantial extent. Each of the price cuts, and in the case of disk drives the 2319B/FTP price cuts upon price cuts, were expressly formulated, analyzed, planned and aimed by IBM specifically at its plug compatible competition. Tape price cuts were substantial and were below, and were planned to be below, the prices charged by IBM's plug compatible competitors, including Telex, whereas IBM knew that, in order to survive, its plug compatible competition would have to charge less than IBM for comparable products. Price cuts through the FTP were accompanied by long term leases with punitive termination provisions planned to foreclose IBM's plug compatible competition from a substantial share of the plug compatible peripheral market on disks, tape and printers and were planned by IBM to foreclose, and did foreclose, IBM's plug compatible competitors from access to most of the plug compatible market for the new 3330 type disk drives, and 3420 type tape drives.

At the time IBM was aiming its price cuts and long term lease plans at its plug compatible competition, it offset those price cuts by price increases in markets in which it was not facing plug compatible competition. Memory price cuts were aimed in important part by IBM at its plug compatible competition and had the effect of substantially suppressing plug compatible competition on these peripheral products. While the so-called control and memory bundling had predominate technological and marketing objectives which in and of themselves cannot be regarded as unlawful, even this action was motivated in part by IBM's anticompetitive intent; but specifically with respect to the memory price cut lack of any such justification rendered this unadulterated predatory action in my opinion. All of these actions were taken by a competitor having a major share of the plug compatible peripheral market and submarkets, of enormous economic size and power and with the studied purpose of containing the competition of its plug compatible competition which was recognized as a threat to its market domination. The record leaves little room to doubt that this course of conduct did not represent normal competitive reactions to be countenanced under Section 2, but willful conduct with predatory intent. Here, as an analogy to the general law on

attempts, there was an effort and intent to achieve, or maintain, an unlawful monopoly, coupled with the apparent present ability to do so, unless checked, in view of the intransigence, skill and organization with which this intent was pursued; and the powerful and resourceful base from which the program was launched.

C27. Thus by unlawful and egregious conduct and with specific intent to maintain and further achieve monopolization under circumstances from which it can be and is fairly inferred that there was a dangerous probability of unlawful monopoly if defendant's conduct remained unchecked, the defendant attempted to monopolize the EDP market for peripheral devices and each part thereof. The court further finds accordingly that defendant has been guilty of violating Section 2 of the Sherman Act not only by monopolization but by an attempt to monopolize.

D. Restraint of trade

C28. Plaintiffs in addition to their claims of monopoly and attempt to monopolize under Section 2 of the Sherman Act assert that under Section 1 of that Act IBM's FTP and ETP agreements with their users covering disks, tapes, printers and communication controllers constituted agreements in unreasonable restraint of trade in violation of Section 1, citing Albrecht v. Herald Co., 390 U.S. 145 (1968). In construing the Sherman Act's prohibition against contracts, combinations and conspiracies "in restraint of trade or commerce among the several states" the courts have long applied a rule of limiting the reach of that section to contracts which unreasonably or unduly restrain trade. Standard Oil Company of New Jersey v. United States, 221 U.S. 1 (1911). Every contract may be said to restrain trade to some degree. Applying the "rule of reason" the courts have separated from such ordinary commercial agreements necessary for the conduct of trade, types of contracts which fall within relatively narrow and increasingly well defined categories deemed unreasonably in restraint of trade either as a matter of law or fact. Contracts and conduct not proscribed by Section 1 may, and in this case do, impinge upon the inhibitions of Section 2. I have concluded that the leases in question would not be unlawful without the monopoly power held possessed by IBM or the found attempt to monopolize.

C29. Agreements reached under IBM's fixed term and extended term plans are commonplace commercial agreements fixing the terms and conditions upon which users may lease some piece of electronic data processing equipment for periods of up to two years. The terms of these leases are limited to provisions governing the use of the particular equipment under lease. They impose in and of themselves no restraints on the freedom of the lessee to trade. They do not obligate the lessee to any exclusive dealing arrangement. They do not obligate the lessee to purchase its requirements of the electronic data processing equipment, supplies or services from IBM. The terms of leases contain no "restraints" of the kind traditionally found violative of Section 1 of the Sherman Act. The terms of the leases are shorter than leases which had been offered by IBM's competitors, including plaintiffs, for some time prior to IBM's adoption of the fixed term and extended term plan. In a different context, the court in United States v. United Shoe Machinery Corp., 110 F. Supp. 295 at 297 (D. Mass. 1953), *aff'd per curiam*, 347 U.S. 521 (1954), *supra*, expressly sanctioned the use of five year term leases despite its conclusion that defendant had monopolized the market for shoe machinery. The court concludes that the leases offered by IBM pursuant to the fixed term and extended term plans are not contracts in restraint of trade violative of Section 1 of the Sherman Act.

E. Integrated functions as tying agreements

C30. Plaintiffs claim that the integration of additional memory and control functions in certain System 370 central processing units is the basis of, or constitutes, tying agreements or arrangements violative of Section 1 of the Sherman Act and Section 3 of the Clayton Act. Section 3 of the Clayton Act prohibits the sale or lease of goods or commodities, or the fixing of a price or discount, on the condition or agreement that the lessee or purchasers thereof shall not deal in the goods of a competitor where the effect of such sale or lease may be substantially to lessen competition or to create a monopoly in any line of commerce. Section 3 of the Clayton Act and Section 1 of the Sherman Act have been applied to proscribe ". . . the forced purchase of a second commodity with the desired purchase of a dominant 'tying' product," Times-Picayune Pub. Co. v. United States, 345 U.S. 594, 614 (1953), where "a party has sufficient economic power with respect to the tying product to appreciably restrain free competition in the market

for the tied product and a 'not insubstantial' amount of interstate commerce is affected." Northern Pac. R. Co. v. United States, *supra,* at p. 6.

For purposes of Section 3 of the Clayton Act and Section 1 of the Sherman Act, ". . . a tying arrangement may be defined as an agreement by a party to sell one product but only on the condition that the buyer also purchases a different (or tied) product . . ." Northern Pac. R. Co. v. United States, *supra*, at 5. It is established by these authorities that for a commercial arrangement to be unlawful as a tying agreement under Section 3 or Section 1, there must exist two distinct products the sale of which is linked. This does not mean that a defendant may avoid judicial scrutiny under Section 3 by pretending that two separate and distinct products are one. Nor can tying consequence be avoided if in fact there is a tying agreement, by putting it in the form or an innocuous arrangement but with the effect, by reason of the products involved, or requiring the purchase of one distinct product as a condition for the acquisition of another. However, where a court is dealing with what is physically and in fact a single product, Section 3 does not contemplate judicial dissection of that product into parts and the reconstruction of these parts into a tying agreement. Colorado Pump & Supply Co. v. Febco, Inc., 472 F. 2d 637 (10th Cir. 1973).

Some the recent cases finding or not finding tying arrangements to be indicated sufficiently explicate the governing considerations to permit disposition of these tying contentions on the basis of the record. Cole v. Hughes Tool Company, 215 F.2d 924 (10th Cir. 1954); Dehydrating Process Co. v. A. O. Smith Corp., 292 F.2d 653 (1st Cir. 1961); MDC Data Centers v. International Business Mach. Corp., 342 F. Supp. 502 (E.D. Pa. 1972); same, 352 F. Supp. 63 (1972); United States v. Jerrold Electronics Corp., 187 F. Supp. 545 (E.D. Pa. 1960), *aff'd per curiam,* 365 U.S. 567 (1961). Cf. Jerrold Electronics Corp .v. Wescoast Broadcasting Co., 341 F.2d 653 (9th Cir.), *cert. denied,* 382 U.S. 817 (1965); City Sportservice, Inc. v. Charles O. Finley and Co., *supra;* Stavrides v. Mellon National Bank & Trust Company, 353 F. Supp. 1072 (W.D. Pa. 1973); McMackin v. Schwinn Bicycle Company, 354 F. Supp. 1154 (N.D. Ill. 1973); Falls Church Bratwursthaus v. Bratwursthaus M. Corp., 354 F. Supp. 1237 (E.D. Va. 1973); Anderson v. Home Style Stores, Inc., 358 F. Supp. 253 (E.D. Pa. 1973). See also International Business Machines Corp. v. United States, 298 U.S. 131, (1936).

C31. Control of memory function has been integrated with processing functions over a long period of time in varying degrees. Technological progress in component miniaturization has made possible the integration of additional memory and control functions and such additional integration has made possible cost reductions and enhanced utility. The integration of which plaintiffs complain involves in form or substance no tying of the sale or lease of one product to that of another. To rule otherwise would enmesh the courts with technical and uncertain inquiry into the technological justifiability of functional integration and cast unfortunate doubt on the legality of product innovations in serious detriment to the industry and without any legitimate antitrust purpose. The integrated control in the System 370 is wholly optional. IBM continues to offer central processing units without integrated controllers. Customers remain free to lease such processing units and to lease independent controllers from IBM, Telex, or whomsoever they choose. The court concludes that the integration of additional controller and memory functions in the System 370 central processing units does not constitute a tying agreement violative of Section 3 of the Clayton Act or Section 1 of the Sherman Act.

C32. Nor do IBM's Fixed and Extended Term Plan leases constitute tying agreements in violation of Section 3 of the Clayton Act or Section 1 of the Sherman Act. It has already been determined that these plans were unlawfully utilized by the defendant with intent to maintain and protect its monopoly control and in this sense they were illegal. Acts which are in themselves legal lose that character when they become constituent elements of an unlawful scheme. Continental Ore Co. v. Union Carbide & Carbon Co., 370 U.S. 690 (1962). However, apart from the offenses of monopolization and attempts to monopolize under the circumstances of this case nothing can be seen in the leases in and of themselves which would constitute a tying arrangement within the prohibitions of Section 3 of the Clayton Act or Section 1 of the Sherman Act. They did not require the lessees to lease any other equipment from IBM. They did not impose any exclusive dealing obligations on the lessees. They did not require the lessees to secure their requirements of data processing services or equipment from IBM. The leases contain no covenants which directly or inferentially impose any tying restrictions on lessee.

The facts that the Fixed Term and Extended Term plans apply to some but not all of the data processing equipment and services does not effect a tying restriction. A lessee of a piece of IBM equipment pursuant to the Fixed Term or Ex-

tended Term plan remains free to select whatever other data processing equipment or services he desires without any contractual restriction. The fact that his choice is limited to equipment compatible with his requirements and may be influenced by the type of other equipment he may independently have does not in my judgment transform the lease into a tying agreement. The fact that a lessee can lease IBM equipment under the Fixed Term or Extended Term plan at a price which is lower than that offered under the IBM's 30 day lease does not transform such plan leases into tying agreements, this situation having become significant only in connection with the monopolization or attempted monopolization findings. The fact that the reduced prices offered may induce a user to utilize IBM equipment and that this utilization will affect his decision concerning other equipment he may wish to use does not establish a tying agreement in my judgment. A user's choice of equipment is inevitably affected by equipment he is currently using and limited by the alternatives which the industry can make available. To rule otherwise might serve to transform most leases of a producer's goods into a tying agreement. The court concludes that leases entered into pursuant to IBM's Fixed Term and Extended Term Plans do not constitute tying agreements violative of Section 3 of the Clayton Act or Section 1 of the Sherman Act, notwithstanding their utilization in violating Section 2 of the Sherman Act.

F. Injury and damage from antitrust violations

C33. Recovery under the Sherman Act is limited to a person who has been "injured in his business or property by reason of" violation of the antitrust laws. 15 U.S.C. § 15. The plaintiffs have the burden of proving that they have in fact been injured and that the injury was caused by the defendant's unlawful conduct. They are required to establish with reasonable probability a causal connection between defendant's allegedly wrongful acts and some loss of anticipated revenue. If all of a plaintiff's loss is caused independent of any unlawful act of a defendant by such factors as lawful economic competition in the marketplace, Dollac Corporation v. Margon Corporation, 164 F. Supp. 41 (D.N.J. 1958), *aff'd*, 275 F.2d 202 (3d Cir. 1960), inefficiency, unfavorable market conditions, or customer dissatisfied. As Judge Doyle aptly stated for the court in Westric Battery Company v. Standard Electric Co., — F.2d —— (10th Cir. No. 72–1734, July 6, 1973), an injured party ". . . is entitled to be compensated for losses attributable to the injury inflicted, but is not entitled to earn a profit or necessarily to come out whole because some of its troubles could be attributable to causes other than the defendant's separators. It must be emphasized that it is only the damages flowing legally from the defendant's misdeeds which count." See also Herman Schwabe, Inc. v. United Shoe Machinery Corp., 297 F.2d (2d Cir.), *cert. denied*, 369 U.S. 865 (1962); Baush Mach. Tool Co. v. Aluminum Co. of America, 79 F.2d 217 (2d Cir. 1935); Momand v. Universal Film Exchanges, 172 F.2d 37 (1st Cir. 1948), *cert. denied*, 336 U.S. 967 (1949); General Electric Credit Corporation v. Grubbs, 478 F.2d 53 (5th Cir. 1973).

C34. Mindful of plaintiffs' burden and various limitations and qualifications, and recognizing that many of Telex's financial difficulties have resulted from the inherent nature of its business of producing products functionally equivalent to those first produced by IBM, competition by firms other than IBM, delay in the introduction of new products, product performance, managerial errors, resistance to its penetration of IBM trade secrets, and operational difficulties to be expected in the industry, yet in my judgment the preponderance of the evidence before me, referred to in my findings, compels the conclusion that IBM's unlawful conduct in violation of Section 2 of the Sherman Act has had not only substantial but severe impact upon the plaintiffs' business and that this impact is established with certainty adequate to satisfy plaintiffs' burden of proving impact or injury. With respect to the amount of plaintiffs' damages the evidence is not as clear. The court recognizes that an antitrust plaintiff has no obligation to prove his damages with absolute certainty. A plaintiff does, however, have the burden of offering evidence upon which the court reasonably may base its damage conclusions, having in mind that the defendant should not be permitted to capitalize upon the effect of its unlawful acts in rendering precise damage computations difficult, nor should the plaintiffs be awarded damages which are merely speculative.

C35. The court, having concluded that the defendant has violated Section 2 of the Sherman Act and that by reason of such violations and as a proximate result thereof the plaintiffs Telex and Telex Computer Corporation have been caused damage in their business and property, is called upon to make a reasonable approximation of the damages to which plaintiffs are entitled if and to the

extent that there is evidence in the record reasonably permitting this. Zenith Radio Corp. v. Hazeltine Research, 401 U.S. 321 (1971); Bigelow v. RKO Radio Pictures, 327 U.S. 251 (1946); Continental Baking Company v. Old Homestead Bread Co., F.2d (10th Cir. 1973); Kobe, Inc. v. Dempsey Pump Co., 198 F.2d 416 (10th Cir.) *cert. denied*, 344 U.S. 837 (1952). As was stated in the *Continental Baking* opinion:

"However, in cases such as this the courts have repeatedly and consistently held the plaintiff to a lower standard of proof than he is nominally required to make . . . 'The most elementary conceptions of justice and public policy require that the wrongdoer shall bear the risk of uncertainty which he has all along created' [Biglow v. RKO Radio Pictures, Inc., *supra*] '. . . This position was recently reaffirmed by the Supreme Court in Zenith . . .' It has been otherwise stated: 'Having best established the factum of damages, the amount thereof may be fairly approximated . . .' " Continental Baking Co. v. Old Homestead Bread Co., *supra*.

C36. The court may measure loss of profits by use of projections or forecasts of future business made in the regular and ordinary course of business, Autowest, Inc. v. Peugeot, Inc., 434 F.2d 556 (2d Cir. 1970). I have found that the damage evidence adduced by Telex is insufficient to support the full amount of its claim based upon the Telex forecasts. The relation between its claim for $257.7 million in lost profits or diminution of market share and any action of IBM involves difficult questions quantitatively and corresponding problems of law. Plaintiffs' claims rest upon the November, 1970, forecast which, as the court has found, involves some questionable features, and projected a higher total than any other forecast by Telex for those products. The January 12, 1972, forecast, against which the earlier forecast was compared, was the lowest forecast Telex ever made for the selected products. The November, 1970, forecast was revised downward almost immediately and the January, 1972, forecast would have required a compound annual growth of 67% which was beyond the ability of Telex to have achieved, in the court's judgment. Moreover, the computations of Telex's damage witnesses, based on the two forecasts, assume that every variation in the number of units forecast were caused by the unlawful actions of IBM. The evidence as to other components of plaintiffs' damage claims also have required weighing and evaluating, as has been done in the findings with the factual results indicated therein. It is believed that these factual determinations, along with the other findings made, are supported by substantial, indeed, preponderating evidence.

C37. Fluctuation in Telex's stock market prices on the basis of which Telex asserts that $149.9 million in damages is indicated is equivocal as proof of damages proximately resulting from IBM's unlawful action, but is supportive to a degree. There is substantial reason for attributing at least a part of this loss to other causes. The court has determined also that Telex's attempt to compare earnings for different periods on the basis of information shown in tax returns must be carefully weighted because of the distinctions between the application of the principles of tax accounting and other generally accepted accounting principles, the differences in Telex's own method of tax and financial accounting and certain inconsistencies in Telex's comparison of 1971 and 1972 taxable income revenues and expenses. In addition, it is apparent that Telex's 1971 and 1972 tax returns cover subsidiaries, divisions and transactions not involved with Telex's domestic EDP business. Telex's income statements do not afford any precise basis for damage computations because they fail to match revenues with expenses in accordance with customary accounting principles and reflect a significant change in Telex's accounting methods effective April 1, 1970, together with a number of fluctuations due to causes which are extraneous to this litigation and unrelated to the competitive behavior of IBM; but, again, they do not appear to be inconsistent with the findings made here.

C38. I have been unable to accept plaintiffs' damage figures on their face as indicating the amount to which they are entitled; it is clear that a portion is attributable to causes for which IBM has no accountability and that they are magnified, if not distorted, by the circumstances indicated. It is equally clear that plaintiffs have sustained serious impact and have suffered substantial damages proximately caused by the unlawful conduct of IBM as herein found. In short, plaintiffs have claimed too much, and they have failed to directly prove what part of their claimed damages was caused by acts for which defendant is legally responsible. But because of the complicated damage picture, resulting in important part from defendant's unlawful action, it is unlikely that anymore specific damage evidence could be submitted short of plaintiffs' conceding the excessive

nature of its claims and introducing expert testimony or other evidence seeking to sustain its claims on a more moderate and realistic basis.

C39. The question remains whether these circumstances preclude any and all recovery by the plaintiffs or whether the court upon the basis of the evidence before it can reasonably approximate plaintiffs' damages for which the defendant is legally responsible. Juries frequently are called upon to make reasonable approximations within the perimeters of parties' claims, and it has not been thought fatal to their verdicts that the amount awarded did not precisely correspond with the claims or expert testimony, but represented an acceptance of the claims in part.

The judgment of a court sitting without a jury, to put the matter modestly as an opinion of a court, should be at least as perceptive and fair in weighing the various points and counterpoints with reference to the amount of damages. Notwithstanding the obligation of a court sitting without a jury to make findings of fact beyond a general verdict, it has been concluded here that detailed and minute findings weighing and allocating portions of claims going to make up the finding of the ultimate fact of damage would be a mechanical process which would be unrealistic and of no more validity, if as much, as finding by fair and reasonable approximation in the judgment of the court the total damages which the court is convinced the plaintiffs have suffered as a direct and proximate result of the unlawful acts of the defendant. Story Parchment Co. v. Patterson Parchment Paper Co., 282 U.S. 555 (1931) ; Agrashell, Inc. v. Hammons Products Company, 479 F.2d 269 (8th Cir. 1973) Continental Baking Co. v. Old Homestead Bread Co., *supra*; Locklin v. Day-Glo Color Corporation, 429 F.2d 873 (7th Cir. 1970), *cert. denied*, 400 U.S. 1020 (1971) ; DeVries v. Starr, 393 F.2d 9 (10th Cir. 1968). See also Perkins v. Standard Oil Co., 395 U.S. 642 (1969). Cf. Continental Ore Co. v. Union Carbide & Carbon Co., 370 U.S. (1962) ; Autowest Inc. v. Peugeot, Inc., 434 F.2d 556 (2d Cir. 1970) ; Flintkote Company v. Lysfjord, 246 F.2d 368 (9th Cir.), *cert. denied*, 355 U.S. 835 (1957) ; Shannon v. Shaffer Oil & Refining Co., 51 F.2d 878 (10th Cir. 1931) ; Peter v. Union Oil Company of California, 328 F. Supp. 998 (C.D. Cal. 1971).

C40. I have endeavored to weigh and consider all of the circumstances as shown by the evidence relating to the amount of plaintiffs' damages with the object of fixing the amount determinable on the basis of a fair preponderance of the evidence, and with the view of discounting any amount which could be deemed speculative or a matter of surmise, or properly deductible expense, but fixing the maximum amount of damages which can be said without speculation or conjecture to have been suffered by plaintiffs as a proximate result of defendant's unlawful actions as herein found. I have sought to eliminate advantage on the part of the plaintiffs stemming from the speculative nature of some of their proof and yet not to penalize them for uncertainties in the proof stemming from the unlawful acts of the defendant.

C41. The court concludes within the perimeter of the proof that Telex and Telex Computer Corporation have sustained damage to their business as a proximate result of defendant's violations of Section 2 of the Sherman Act in the total sum of $117,500,000, which amount must be trebled as required by law; and the plaintiffs are therefore entitled to judgment against IBM in the total amount of $352,500,000, plus reasonable attorneys' fees which the court shall determine upon notice and hearing, and for their costs incurred in prosecuting this action. It is believed and found that any greater amount, although supported by some evidence, would be speculative and not supported by preponderant evidence applying the rule of liberality enjoined by the authorities. Weighing all relevant factors it is believed that any less amount would be contrary to the preponderance of the evidence and accordingly also a miscarriage of justice.

G. Equitable antitrust relief

C42. Any person, firm, corporation or association shall be entitled to sue for and have injunctive relief against threatened loss or damage by a violation of the antitrust laws in harmony with established principels of equity. 15 U.S.C. § 26. Accordingly, it must be determined what equitable relief, if any, should be granted in favor of the plaintiffs and against the defendant for the protection of plaintiffs' rights in the future and in reasonable enforcement of the antitrust laws in the public interest. United States v. Grinnell Corporation, 384 U.S. 563 (1966), *supra;* Reynolds Metals Company v. F.T.C. 309 F.2d 223 (D.C. Cir. 1962), *supra*; United States v. Aluminum Co. of America, 148 F.2d 416 (2d Cir. 1945), *supra*; Zenith Radio v. Hazeltine, 395 U.S. 100, *on remand*, 418 F.2d 21 (7th Cir. 1969) rev'd on other grounds, 401 U.S. 321 (1971) ; Bed-

ford Cut Stone Co. v. Journeyman Stone Cutters', Inc., 274 U.S. 37 (1927); Swift & Company v. United States, 196 U.S. 375 (1905); United States v. Oregon State Medical Soc., 343 U.S. 326 (1952); United States v. W. T. Grant Co., 345 U.S. 629 (1953); Calnetics Corporation v. Volkswagen of America, Inc., 353 F. Supp. 1219 (C.D. Cal. 1973). Injunctive relief should not be utilized when not essential for the protection of a litigant's rights or when it would be injurious to the public interest by preventing technological developments or in aid of further anticompetitive conduct, and the courts uniformally have rejected efforts of litigants to use the courts to create or enforce illegal agreements. See Continental W. P. Co. v. Louis Voight & Sons Co., 212 U.S. 227 (1909); Kelly v. Kosuga, 358 U.S. 516, 520 (1959); Winston Research Corp. v. Minnesota Min. & Mfg. Co., 350 F.2d 134 (9th Cir. 1965); Kentucky Rural Elec. Coop. Corp. v. Meloney Elec. Co., 282 F.2d 481, 482 (6th Cir. 1960), *cert. denied*, 365 U.S. 812 (1961); Ful-Vue Sales Co. v. American Optical Co., 118 F. Supp. 517 (S.D.N.Y. 1953); Farbenfabriken Bayer A. G. v. Sterling Drug, Inc., 307 F.2d 207 (3d Cir. 1962), *cert. denied*, 372 U.S. 929 (1963); United States v. Columbia Artists Management, Inc., 1963 CCH Trade Cas. ¶ 70,955 (S.D.N.Y. 1963). Nor should the court unnecessarily involve itself in the task of the administration of prices, product designs and technological applications or other functions neither contemplated under the antitrust laws nor properly performed by the judiciary. See Booth v. American Telephone and Telegraph Company, 253 F.2d 57, 58 (7th Cir. 1958); Montana-Dakota Utilities Co. v. Northwestern Public Service Co., 341 U.S. 246 (1951); United States v. Pullman Co., 64 F. Supp. 108, 110 (E.D. Pa. 1945), *aff'd per curiam*, 330 U.S. 806 (1947).

C43. Applying the established principles of these cases to the facts found. and in reasonable relief to the plaintiffs and protection to the public, the decree herein should contain the following equitable remedies on the plaintiffs' antitrust claims:

(a) The defendant should be permanently enjoined from enforcing or collecting any contractually specified penalty payments which it otherwise might be entitled to collect because of termination upon ninety days' notice of any long term lease agreements heretofore entered into between IMB and any of its end-user customers, including but not limited to IBM Fixed Term Plan leases, Extended Term Plan leases and Term Lease Plan leases. For a period of three years from and after the date of this judgment it should be enjoined and prohibited from including in any lease agreement for electronic data processing products for terms in excess of 90 days any provision requiring payment of any liquidated damages or penalty because of a customer's earlier termination of said lease agreement.

(b) The defendant should be enjoined and required, at the time of a product announcement concerning any peripheral EDP product, or at the time of release for manufacturing or production, whichever first occurs, to publicly describe and disclose the design of the electronic interface for such product essential for connection to a CPU or its channel, in sufficient detail as to render reasonably feasible the reproduction of such interface by other qualified manufacturers; and within 60 days from the entry of this judgment International Business Machines Corporation should be ordered to similarly describe and disclose the details of the design of the electronic interface for each System 370 peripheral EDP product announced heretofore.

(c) The defendant should be enjoined and prohibited from single or "bundled" pricing of memories with its System 370 central processing units, that is, from charging a single price for both the central processing unit and the memory, and within 60 days from the entry of the judgment herein IBM shall separately price its CPU's and memories. This should not prohibit, restrict or enjoin IBM from selecting the physical locations of its products so long as these requirements and those stated in the next succeeding paragraph are followed.

(d) The defendant should be enjoined and required to separately price its functionally different products, including memories, tape products and their controllers, disk products and their controllers, printer products and their controllers and communication controllers regardless of whether it elects to place such products in single cabinets or in multiple boxes or cabinets. International Business Machines Corporation is further enjoined and required to set its prices for all such functionally similar EDP products by using and applying a substantially uniform percentage markup over actual design, manufacturing and marketing costs as between such integrated and separately boxed products.

(e) The defendant should be enjoined from adopting, implementing or carrying out predatory pricing, leasing or other acts, practices or strategies with

intent to obtain or maintain a monopoly in the market for EDP peripheral equipment plug compatible to its CPU's, or any relevant submarkets thereof.

(f) The court should decline to order either the public disclosure by IBM of all planned or anticipated product enhancements, or the divestiture of IBM's holdings, for the reasons more fully developed in the findings, *supra*.

H. Telex' misappropriation of trade secrets and confidential information—unfair competition

C44. In view of the programmed and massive invasion by Telex of IBM's trade secrets already found, it is not deemed necessary here to analyze the law of trade secrets in general or to discuss fine distinctions and qualifications of which I have been mildful. See *e.g.*, Motorola, Inc. v. Fairchild Camera & Instr. Corp., F. Supp. (D.C. Ariz., March 13, 1973) : Sears, Roebuck & Co. v. Stiffel Co., 376 U.S. 225 (1964) ; Compco Corp. v. Day-Brite Lighting, 376 U.S. 234 (1964) ; Sarkes Tarzian, Inc. v. Audio Devices, Inc., 166 F. Supp. 250 (S.D. Cal. 1958), *aff'd*, 283 F. 2d 695, *cert. denied*, 365 U.S. 869; A. O. Smith Corporation v. Petroleum Iron Works Co., 73 F. 2d 531 (6th Cir. 1934). The facts here go beyond the mere termination of employment and the acceptance of employment from a competitor; disclosures to employers of information acquired during the course of previous employment which was a matter of general knowledge or information as it might be retained in memory; the utilization of skills, expertise and general technical and business information learned in former employment; the employment of "key" employees of a former employer to obtain skills and knowledge in the usual course of business; the obtaining or disclosure of data not confidential or which do not constitute trade secrets reasonably protected by others; information disclosed by the products marketed; the disclosure of information that could not be considered to have been "discovered"; the disclosure of information readily available from other sources; or matters which are generally known in the trade or readily discernible by those skilled in the trade, and such circumstances.

C45. The trade secrets or confidential information found here clearly fall within the definition of formula, patterns, business plans, compilations of information or technical knowledge which were used in IBM's business, which were important in that business, which were treated and sought to be protected as confidential to IBM for the purposes of its business, and which entitled IBM for the purposes of its business, and which entitled IBM legitimately, by reason of its exceptional diligence, technology and discovery to obtain legitimate competitive advantage over competitors not possessing such knowledge or information and not able, legitimately and within a reasonable time frame, to obtain it otherwise. Telex obtained these trade secrets from IBM by a massive and pervasive program designed to induce the breach of known obligations of IBM employees or former employees. That such information or part of it could have been subsequently procured by Telex, given enough time and expense, by independent investigation, research or experience, did not justify Telex's conduct. That subsequent to the invasion of IBM's trade secrets a portion of the information in the course of marketing of IBM products became available to the public, including Telex, did not excuse Telex's conduct in the first instance nor insulate it from liability to both monetary and equitable relief. See Restatement of Torts § 757; Restatement of Agencies § 395. 21 Okla. Stat. Ann § 1730 (Supp. 1968) ; Bancroft Whitney Co. v. Glen, 64 Cal. 2d 327, 49 Cal Rptr. 825, 411 P.2d 921 (1966) ; By-Buk Co. v. Printed Cellophane Tape Co., 163 Cal. App. 157, 319 P.2d 247 (D. Ct. App. 2d Dist. 1958) ; Sperry Rand Corporation v. Rothlein, 241 F. Supp. 549 (D. Conn. 1964) ; Restatement of Torts, § 396; Restatement of Agency §312; Ferroline Corp. v. General Aniline & Film Corp., 207 F.2d 912 (7th Cir. 1953), *cert. denied*, 347 U.S. 953 (1954) ; Atlantic Wool Combing Co. v. Norfolk Mills, Inc., 357 F.2d 866 (1st Cir. 1966) ; A. H. Emery Co. v. Marcan Products Corporation, 389 F.2d 11 (2d Cir.), *cert. denied*, 393 U.S. 835 (1968) ; Hulsenbush v. Davidson Rubber Company, 344 F.2d 730 (8th Cir. 1965), *cert. denied*, 283 U.S. 977; Englehard Industries, Inc. v. Research Instrumental Corpor., 324 F.2d 347 (9th Cir. 1963), *cert. denied*, 377 U.S. 923 (1964) ; Midland-Ross Corporation v. Yokana, 293 F.2d 411 (3d Cir. 1961) ; Schreyer v. Casco Products Corp., 190 F.2d 921 (2d Cir. 1951), *cert. denied*, 342 U.S. 913 (1952) ; Shellmar Products Co. v. Allen-Qualley Co., 87 F.2d 104 (7th Cir.), *cert. denied*, 301 U.S. 695 (1937) ; Standard Brands Inc. v. U.S. Partition & Packaging Corp., 199 F. Supp. 161 (E. D. Wisc 1961) ; Sperry Rand Corporation v A-T-O, Inc., 557 F.2d 1387 (4th Cir. 1971), *cert. denied*, 405 U.S. 1017

(1972); Monsanto Chemical Co. v. Miller, 118 U.S.P.Q. 74 (D.C. Utah 1958); Dubuque Products Inc. v. Lemco Corporation 227 F. Supp. 108 (D. Utah 1963).

C46. On the basis of the facts found from the record, it is concluded that Telex knowingly induced Mr. James to breach his fiduciary obligations to IBM and willfully misappropriated IBM's trade secrets concerning the planning of future products, to IBM's substantial damage.

C47. The court concludes that Telex knowingly and deliberately misappropriated IBM trade secrets in the design of the Aspen products and used those secrets in marketing its 6420/6803 tape products to IBM's substantial damage and in unjust enrichment to Telex. IBM was injured by Telex's misappropriation of the Aspen trade secret in an amount to be reasonably approximated in relationship to IBM's investment in the Aspen research and by the rental revenues which IBM would likely have enjoyed but for the early marketing of Telex's 6420/6803 products.

C48. The court concludes that Telex has knowingly sought, obtained and used confidential trade secret information relating to IBM's Merlin and FRIEND–2 program as a conscious part of a recruitment effort directed to IBM employees possessing or having access to that information. Telex recruited and hired these IBM employees at least in part for the trade secrets they had or knew. After their employment Telex disregarded the prior agreements between these employees and IBM and used these trade secrets and the proprietary FRIEND–2 program and source code in the development of Telex's Merlin controller, and otherwise, to IBM's substantial damage and Telex's unjust enrichment.

C49. The court further concludes on the basis of the facts found in the record that Telex has engaged in a continuing course of activity calculated to induce the disclosure by IBM employees of IBM confidential information in breach of their fiduciary obligations to IBM so that Telex can misappropriate such information to its own use and benefit. The court here deals not with isolated instances of misappropriation by Telex, nor are we concerned merely with the recruitment by Telex of persons knowledgeable in the design and manufacture of electronic data processing equipment for the primary purpose of developing competitive equipment. We have been confronted here by a widespread, purposeful effort of Telex to secure confidential technical information concerning the design of products which were then unannounced, for the purpose of duplicating such equipment through use of such confidential information. Telex's pattern of recruitment, job assignment, production growth and compensation arrangements, were so designed as to lead inevitably to the misappropriation of IBM's confidential information. Telex's past pattern of conduct makes it apparent that such misappropriation will continue unless the court provides protection commensurate with the threat posed by Telex's deliberate and continuing course of improper behavior with respect to the invasion of IBM's trade secret and confidential information.

C50. The court further concludes that IBM's counterclaim relating to unfair competition and the misappropriation of trade secrets and confidential information is not barred by the statute of limitations. The parties agree that the court should look to the conflicts law of Oklahoma to determine the applicable statute of limitations, although Telex at one time suggested that it might be appropriate to invoke the substantive law of another state. It is concluded that the Oklahoma statute of limitations law ought to be applied since the counterclaim asserted by IBM arose within the State of Oklahoma. Telex's misappropriation of IBM confidential material was centered in Tulsa. The decisions reached in the course of Telex's practice were made and largely implemented in Tulsa. Almost all the hired IBM engineers were entertained in Tulsa, were offered bonuses in Tulsa, and those that went to Telex signed contracts in Tulsa. The Telex copy of the Aspen products, S6803/6420 tape subsystem, was manufactured in and marketed from Tulsa and the court concludes that these claims arose in the State of Oklahoma. There is no reason to suppose that the result would be different had they arisen within the State of California.

C51. IBM asked the court to conclude that under Oklahoma law the counterclaim is "connected with the subject of the action within the meaning of Section 273 of Title 12 of Oklahoma Statutes Ann. 1960, and thus cannot be barred unless the complaint is barred, citing Meyer 1. Vance, 406 P.2d 996 (Okla. 1965); Perrault v. Holland, 360 P.2d 240 (Okla. 1961); Gooldy v. J. B. Klein Iron & Foundry Co., 170 Okla. 466, 40 P.2d 1070 (1935); Guy Harris Buick Co. v. Bryant, 108 Okla. 117, 233 Pac. 752 (1925). It is true as contended that the primary claims and counterclaims are intertwined to an extent and

the trial has disclosed that the evidence to a degree was interrelated. This was among the reasons leading me to deny plaintiffs' motion for severance of the counterclaim. Because this is a federal case, the counterclaim is brought pursuant to Rule 13(a) Fed. R. Civ. P., rather than 12 Okla. Stat. Ann. § 273 (1960). Nevertheless, even though no Oklahoma case closely in point has been found, it seems likely that the Oklahoma courts, on facts similar to those here, would find the counterclaim permissible under § 273, and therefore subject to the same limitation period as the plaintiffs' cause of action. In any event, I am of the opinion that IBM's misappropriation counterclaim is not time barred also because it involves a continuing wrongful course of action pursued to within two years of the filing of the counterclaim—the shortest limitations period contended for by Telex and applicable to tort claims in general. 12 Okla. Stat. Ann. § 95. There is force to the contention of IBM that its counterclaim comes under the Oklahoma three-year statute of limitations because the IBM claim lies in unjust enrichment.

The Oklahoma stature provides a three year limitation to causes of action arising out of "express or implied contracts not in writing." 12 Okla. Stat. Ann. § 95 (1960). See Bidleman v. National Feeders Service, 268 F. Supp. 904 (W. D. Okla. 1967); Koehring Company v. National Automatic Tool Co., 257 F. Supp. 282 (S.D. Ind. 1966), *aff'd per curiam*, 385 F.2d 414 (7th Cir. 1967). From another viewpoint, the gist of the claim is the use of the trade secrets, not necessarily their acquisition, and in this sense the statute would not commence to run prior to any such use and, with the period renewed by its continuance. See Underwater Storage, Inc. v. United States Rubber Co., 371 F. 2d 950 (D.C. Cir. 1966), *cert. denied*, 386 U.S. 911 (1967); Koehring Co. v. National Automatic Tool Co., *supra*. But compare Monolith Portland Midwest Co. v. Kaiser Aluminum & Chemical Corp., 407 F.2d 288 (9th Cir. 1969); Shatterproof Glass Corp. v. Guardian Glass Co. 322 F. supp. 984 (E.D. Mich. 1970), *aff'd*, 462 F.2d 1115 (6th Cir. *cert. denied*, 409 U.S. 1039 (1972). Telex continued to seek and did obtain IBM business planning information after January, 1971. Gruver continued to use IBM trade secrets in the design of the Telex 6803 control unit after January, 1971, and Telex shipped its first unit in November, 1971. After January, 1971, Clemens and his IBM recruits continued to make use of IBM trade secrets in attempting to construct the Merlin control unit and Telex used these secrets to induce prospective buyers. After January, 1971, Telex continued to use the IBM FRIEND program and sold the FRIEND source deck to CDC. Since January, 1971, Telex has attempted to interest other manufacturers in the then unannounced IBM products named Winchester, Midas, Birch, Apollo and Iceberg.

C52. Moreover, the Oklahoma statute and the cases make it abundantly clear that fraudulent concealment by a wrongdoer of the injured party's cause of action will toll the statute of limitations until the injured party is placed on reasonable notice of the wrong. See 12 Okla. Stat. Ann. § 95) (1960); Morris v. Wise, 293 P2d 547, 55 A.L.R. 2d 1033 (Okla. 1955); Moses v. Miller, 202 Okla. 605, 216 P.2d 979 (1950); Waugh v. Guthrie Gas, Light, Fuel & Improvement Co., 37 Okla. 239, 131 Pac. 174, LRA 1917B 1253 (1913). See also Murray v. Teape, 260 P.2d 727 (Okla. 1953); Holmes v. McKay, 383 P.2d 655 (Okla. 1962).

No evidence has been called to my attention to suggest that IBM learned, or should have learned, of the misappropriation more than two years prior to the filing of its counterclaim, and the preponderance of the evidence indicates that up to two years prior to that filing IBM was justified in assuming that there was no utilization of its trade secrets of the nature here found. In addition, IBM's discovery of the misappropriation was no doubt delayed by Telex's attempted concealment of the facts from IBM. IBM was led by Telex and the ex-IBM engineers to believe that these employees were honoring their obligations to IBM and refraining from utilizing IBM confidential information and that Telex has ceased recruiting IBM engineers. Up to the very time of the trial Telex and various of its employees formerly working for IBM have insisted that no confidential information was used; and only upon full inquiry at the trial did it appear clear that such protestations could not be accepted. Absent such searching inquiry in open court and the discovery made by IBM following the filing of the complaint by Telex, it seems possible that IBM could yet be ignorant of the extent, or even the existence, of the actionable misappropriation. Under all these circumstances the court rules that IBM's said counterclaim is not barred by any statute of limitations. See Wills v. Black and West, 344 P.2d 581 (Okla. 1959); Kansas City Life Ins. Co. v. Nipper, 174 Okla. 634, 51 P.2d 741 (1935);

McClenahan v. Oklahoma R. Co., 131 Okla. 73, Pac. 657 (1928); Waugh v. Guthrie Gas, Light, Fuel and Improvement Co. 37 Okla. 239, 131 Pac. 174, LRA 1917 B 1253. Cf. Public Service Co. of New Mexico v. General Electric Co., 315 F.2d 306 (10th Cir.), *cert. denied*, 374 U.S. 809 (1963).

I. Conclusions concerning infringement of copyright material

C53. IBM claims that its copyrights in six copyrighted publications have been infringed in one or more of a total of twelve Telex manuals or publications. The IBM publications relate to and are marketed for the use of IBM customers and IBM maintenance personnel in connection with several different IBM products. A valid certificate of copyright was issued by the Registrar of Copyrights in respect of each of the publications involved and each is therefore entitled to prima facie presumption of authorship, originality, copyrightability and compliance with statutory copyright formalities. Tennessee Fabricating Co. v. Moultrie Mfg. Co., 421 F. 2d 279 (5th Cir.), *cert. denied*, 398 U.S. 928 (1970); Flick-Reedy Corp. v. Hydro-Line Mfg. Co., 351 F.2d 546 (7th Cir.), *cert. denied*, 383 U.S. 958 (1970); Drop Dead Co. v. S. C. Johnson & Son, Inc., 326 F. 2d 87 (9th Cir. 1963), *cert. denied*, 377 U.S. 907 (1964); Harcourt, Brace and World, Inc. v. Graphic Controls Corps., 329 F. Supp. 517 (S.D.N.Y. 1971). Telex has offered no evidence to overcome this presumption. Telex admits that it is guilty of the infringement alleged in Count 1. Each of the Telex publications complained of in the remaining counts of the counterclaim likewise contain portions identical or virtually identical to portions of the other five IBM manuals.

Telex has offered no explanation for these substantial identities. The similarities are such that this court would be hard pressed to find any reasonable explanation other than deliberate copying. Telex asserts by way of defense that simple directions dictated by functional considerations, even if original, do not contain sufficient intellectual labor to constitute writing, and that apart from the particular tangible form and manner of their composition or presentation, ideas, methods and systems are not proper subjects of copyright and are not protected from appropriation by others. I do not question these general propositions but the authorities cited by plaintiffs to sustain them readily demonstrate that they are not in point. E. H. Tate Co. v. Jiffy Enterprises, Inc., 16 F.R.D. 571 (E.D. Pa. 1954) for example involved small sketches by the alleged infringer and a legend "apply to wall". Two of the cited authorities, Guthrie v. Curlett, 36 F.2nd 694 (2d Cir. 1929), and Gordon v. Weir, 111 F. Supp. 117 (E.D. Mich. 1953), seem to fully support defendant's position. Eisenschiml v. Fawcett Publications, 246 F.2d 598 (7th Cir. 1957), and Morrissey v. Proctor & Gamble Co., 379 F.2d 675 (1st Cir. 1967), appear more nearly in point and teach respectively that de minimis copying and availability of only limited number of forms of expression in giving directions for a box top content may justify a decison of noninfringement. Crume v. Pacific Mut. Life Ins. Co., 140 F.2d 182 (7th Cir. 1944), which on the surface may appear in point to a degree, clearly draws the distinction when it notes: "The description of the art in a book, though entitled to a benefit of copyright, lays no foundation for an exclusive claim to the art itself. The object of the one is explanation; the object of the other is use. The former may be secured by copyright. The latter can only be secured, if it can be secured at all, by letters patent."

C54. Certain Telex manuals relate to the Itel/ISS-made 5314 disk drive subsystem and on their face purport to be Itel/ISS publications. Assuming that the actual copying was performed by Itel/ISS, that fact does not immunize Telex against the claim of infringement under the circumstances of this case. These manuals are used to facilitate maintenance, preventive maintenance and operation of the Telex 5314: Telex has the exclusive marketing rights for the 5314 and provides service as part of its marketing of that device. Telex's interest and participation in the distribution of these manuals are such that Telex is clearly a related or contributory infringer and jointly and severally liable with Itel/ISS for the copying of the IBM manuals. Buck v. Jewell-LaSalle Realty Co., 283 U.S. 191 (1931); Shapiro, Bernstein & Co. v. H. L. Green Co., 316 F.2d 304 (2d Cir. 1963; Bradbury v. Columbia Broadcasting System, Inc., 287 F.2d 478 (9th Cir.), *cert. dismissed*, 368 U.S. 801 (1971); Screen Gems-Columbia Music Inc. v. Mark-Fi Records, Inc., 327 F. Supp. 788 (S.D.N.Y. 1971), *rev'd on other grounds*, 453 F.2d 552 (2d Cir. 1971); Davis v. E. I. Du Pont De Nemours, 240 F. Supp. 612 (S.D.N.Y. 1965).

C55. The fact that some pages of infringing Telex manuals do not contain infringing material copied from an IBM manual does not exonerate Telex for the portion which is infringed, for the presence of original elements in the copied

matter does not relieve the infringer of liability if the infringed material is substantial. Davis v. E. I. Du Pont De Nemours, *supra*. The exact proportion of the copied material to the total volume of the work is immaterial, and it is sufficient if a material and substantial part shall have been copied even though it be a small part of the whole. See Henry Holt & Co. v. Liggett & Myers Tobacco Co., 23 F. Supp. 302 (E.D. Pa. 1938).

C56. The doctrine of "fair use" clearly is inapplicable to the facts of this case. That doctrine permits limited use of material protected by statutory copyright, such as in book reviews, newspapers or scientific journals, in order more fully to promote the ultimate goals of copyright laws. Telex's use of the materials copied from IBM materials evidence only a purpose to appropriate IBM's creative efforts for Telex's own profit, precluding application of the "fair use" doctrine. Tennessee Fabricating Co. v. Moultrie Mfg. Co., 421 F.2d 279 (5th Cir.), *Cert denied*, 398 U.S. 928 (1970), *supra*

C57. The court concludes that each of the twelve Telex manuals constitutes an infringement of IBM's copyright in one or more IBM manuals. As a result of Telex's infringement, IBM is entitled to an injunction against continuing infringement. 17 U.S.C. § 101(b) (1947). IBM is also entitled to statutory damages under the Copyright Act, 17 U.S.C. § 101(b), in the amount of $250 for each infringement and $1 for each additional infringing copy. Since two of the Telex manuals each infringed two IBM manuals, publication of the twelve manuals constitutes fourteen separate infringements of the six IBM manuals. L .A. Westermann Co. v. Dispatch Printing Co., 249 U.S. 100 (1919); Bacarro v. Pisa, 252 F. Supp. 900 (S.D.N.Y. 1966); Harry Alter Co. v. A. E Borden Co., 121 F. Supp. 941 (D. Mass. 1954). The Telex manuals are utilized and distributed by Telex in connection with the marketing of the various Telex devices to which they relate. Calculation of the statutory damages on the basis of the number of units shipped of each device relating to each infringement by each Telex manual results in a total of $13.776. In addition IBM is entitled to the destruction of all copies of the infringing Telex manuals insofar as still under the control of Telex, 17 U.S.C. § 101(d), and reasonable costs and attorneys' fees. 17 U.S.C. § 116.

J. Remedial provisions under counterclaim

C58. Accordingly, the court concludes that IBM is entitled to an injunction ordering Telex:

(a) To return to IBM all IBM documents and all Telex documents containing IBM confidential information which are in Telex's custody or under its control, and to destroy all copies of Telex manuals under its control or in its custody which infringe IBM copyrighted manuals.

(b) To refrain from hiring or soliciting any IBM employe for a period of two years without approval from the court.

(c) To refrain from copying any IBM copyrighted materials.

(d) To refrain from soliciting or using any IBM confidential or proprietary information.

(e) To refrain from assigning any former IBM employee employed now or in the future by Telex to the development or manufacture of products functionally equivalent or similar to those on which such employee worked at IBM for a period of not less than two years following the termination of his employment with IBM.

C59. The court further concludes that IBM is entitled to damages in the following amounts on its counterclaims:

(a) Statutory damages for copyright violation in the amount of $13.776.

(b) $4.5 million for losses through December of 1972 in monthly rentals of 3803 and 3420 units as a result of the acclerated shipments of Telex 6803 and 6420 replacement units which were made possible by the misappropriation of IBM's trade secrets.

(c) $13 million in damages, as in the findings more particularly indicated, measured by the additional advantages secured by Telex in the development of its Aspen and Merlin type products through misappropriation of the defendant's trade secrets.

(d) $3 million for the costs of increased security in 1971 and 1972.

(e) $400.000 for the additional cost of manufacturing the IBM Merlin head arm within IBM.

C60. In light of the willful, deliberate and pervasive nature of Telex's unlawful conduct, the court further concludes that IBM is entitled to punitive damages in the amount of $1 million.

K. Conclusion

C61. In sum, under the facts and the law of the case it has been concluded that plaintiffs' complaint has required vindication in the manner provided above in justice to them and in aid of proper competition; that defendant's counterclaims similarly have required vindication in justice to it and in discouragemet of improper competition.

Dated this 14th day of September, 1973.

A. SHERMAN CHRISTENSEN,
Senior U.S. District Judge (Assigned).

IN THE UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF OKLAHOMA

No. 72–C18, No. 72–C–89 (Consolidated)

THE TELEX CORPORATION AND TELEX COMPUTER PRODUCTS, INC., PLAINTIFFS

versus

INTERNATIONAL BUSINESS MACHINES CORPORATION, DEFENDANT.

JUDGMENT AND DECREE

The issues having been duly tried to the court, findings of fact having been made, and conclusions of law having been entered; now, according, it is hereby ordered, adjudged and decreed:

1. That plaintiffs, The Telex Corporation and Telex Computer Products, Inc., have and recover judgment of and from the defendant International Business Machine Corporation in the sum of $352.5 million, after they found actual damages have been trebled as required by law, together with costs and attorneys' fees, the amount of such attorneys' fees to be reserved for future determination.

2. International Business Machines Corporation is hereby permanently enjoined from enforcing or collecting any contractually specified penalty payments which it otherwise might be entitled to collect because of termination upon ninety days' notice of any long term lease agreements heretofore entered into between IBM and any of its and-user customers, including but not limited to IBM's Term Plan leases, Extended Term Plan leases and Term Lease Plan leases. For a period of three years from and after the data of this judgment International Business Machines Corporation is enjoined and prohibited from including in any lease agreement for electronic data processing products for terms in excess of 90 days any provision requiring payment of any liquidated damages or penalty because of the customer's earlier termination of said lease agreement.

3. At the time of a product announcement concerning any EDP product, or at the time of release of such product for manufacturing and production, whichever first occurs, International Business Machines Corporation is enjoined and required to publicly describe and disclose the design of the electronics interface for such product in sufficient detail as to make feasible the reproduction of such interface by other qualified manufacturers; and within 60 days from the entry of this judgment, International Business Machines Corporation shall similarly describe and disclose the details of the design of the electronic interface for each System 370 EDP peripheral product that it has announced heretofore.

4. International Business Machines Corporation is enjoined and prohibited from single or "bundled" pricing of IBM memories with its System 370 central processing units, that is, from charging a single price for both the central processing unit and the memory, and within 60 days IBM shall separately price its CPU's and memories. This does not prohibit, restrict or enjoin International Business Machines Corporation from selecting any particular physical locations or packaging of its products so long as these requirements and those stated in the next succeeding paragraph are followed.

5. International Business Machines Corporation is enjoined and required to separately price its functionally different products, including but not limited to central processing units (CPU's), memories, tape products and their controllers, disk products and their controllers, printer products and their controllers and communication controllers regardless of whether it elects to place such products

in single cabinets or in multiple boxes or cabinets. International Business Machines is further enjoined and required to set its prices for all such functionally different EDP products by using or applying a substantially uniform percentage markup over actual designing, manufacturing and marketing costs as between such integrated and separately boxed products.

6. International Business Machines Corporation is enjoined from adapting, implementing or carrying out predatory pricing, leasing or other acts, practices or strategies with intent to obtain or maintain a monopoly in the market for EDP peripheral equipment plug compatible to its CPUs, or any relevant submarkets thereof.

7. International Business Machines Corporation shall have and recover from Telex Corporation and Telex Computer Products, Inc., the total sum of $21,913,776, made up as by the Conclusions of Law shown, together with costs and attorneys' fees in connection with its copyright claim to be hereinafter fixed.

8. Telex Corporation and Telex Computer Products Incorporated are enjoined:

(a) To return to IBM all IBM documents and all Telex documents containing IBM confidential information which are in Telex's custody or under its control, and to destroy all copies of Telex manuals under its control or in its custody which infringe IBM copyrighted manuals.

(b) To refrain from hiring or soliciting any IBM employee for a period of two years without approval from the court.

(c) To refrain from copying any IBM copyrighted materials.

(d) To refrain from soliciting or using any IBM confidential or proprietary information.

(e) To refrain from assigning any former IBM employee employed now or in the future by Telex to the development or manufacture of products functionally equivalent or similar to those on which such employee worked at IBM for a period of not less than two years following the termination of his employment with IBM.

9. Except for the fixing of the amounts of attorneys' fees and costs to which the respective parties are entitled, the court pursuant to Rule 54(b) Fed. R. Civ. P. determines that there is no just cause for delay in the entry of this judgment, and the clerk is hereby directed to enter final judgment in accordance with the foregoing forthwith on all issues except as to the amounts of the attorneys' fees, which shall be covered by supplemental judgment, there being hereby granted a stay of execution until the disposition of the post-trial motions hereinafter mentioned, or until the court otherwise orders.

10. For the purposes of fixing the amounts of said atterneys' fees, considering any motions filed within ten days of the entry of this judgment for correction of the findings of fact, conclusions of law and judgment pursuant to Rule 60(a) Fed. R. Civ. P., or to amend findings and judgment pursuant to Rule 52(b) Fed. R. Civ. P., or to alter or amend judgment or for a new trial pursuant to Rule 59(a), (e), Fed. R. Civ. P., a hearing will be held at the United States Courthouse, Tulsa, Oklahoma, on October 16, 1973, beginning at the hour of 10 o'clock A.M.

Dated this 14th day of September, 1973.

A. SHERMAN CHRISTENSEN,
Senior U.S. District Judge (Assigned).

[Filed Nov. 10, 1973]

IN THE UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF OKLAHOMA

No. 72-C-18, No. 72-C-89 (Consolidated)

THE TELEX CORPORATION and TELEX COMPUTER PRODUCTS, INC., PLAINTIFFS,

versus

INTERNATIONAL BUSINESS MACHINES CORPORATION, DEFENDANT.

AMENDMENTS TO FINDINGS OF FACT

The defendant having moved to correct, amend or alter the court's findings of fact filed September 17, 1973, concerning damages and injunctive relief, and

the court having reconsidered the record and having heard arguments and deeming itself fully advised, it is hereby ordered that:

The following amendments to the court's findings of fact are hereby made and entered and in all other respects the court's findings of fact as heretofore made and entered shall remain in full force and effect.

The title preceding finding 1 on page 1 is amended to read "Amended Findings of Fact and Conclusions of Law".

The first paragraph of finding F9 is amended by adding thereto the following:

> On September 17, 1973, findings of fact, conclusions of law and judgment and decree were filed. On October 16–18, 1973, timely post-judgment motions for correction and amendment thereof were argued to the court and submitted for decision on supplemental briefs.

The second paragraph of finding F9 is amended to read as follows:

> The court, now deeming itself fully advised, makes the following amended Findings of Fact in addition to the statement of the case and proceedings set out above, and the minute stipulated facts not set out, including but not limited to the (i) Stipulation of Background Facts Concerning the Electronic Data Processing Industry, the Products, the Industry, the Parties and the Issues, dated March 23, 1973, (ii) Stipulation of Fact No. 2, dated April 12, 1973, (iii) Stipulation of Fact No. 3, dated April 7, 1973, and (iv) Defendant's Exhibit 1662 (an exhibit compiling plaintiffs' admissions introduced at trial), but incorporated herein by reference since there is no contest with respect to them.

Finding F19 is amended by adding:

> The products and systems formerly manufactured and marketed by RCA and GE remain in the market and are now being maintained, serviced and remarketed by Honeywell and Sperry Rand. As a result Honeywell and Sperry Rand probably have been strengthened and their ability to compete with IBM enhanced by their acquisition of the computer operations of RCA and GE.

Finding F21 is amended by adding after the fourth sentence the following sentence:

> During the late 1960's a substantial quantity of the initial leases relating to the $2.6 billion worth of IBM 360 computer equipment mentioned above were expiring and during the late 1960's and early 1970's leasing companies were engaged in remarketing that EDP equipment.

Finding F38 is amended by adding the following provision after the fourth sentence:

> For example, the IBM Merlin (3330) disk drive was believed by IBM to be a critical factor to the competitive price/performance of the 370 systems 135, 145, 155, 158, 165 and 168. The 3330 was therefore announced in June of 1970 at a price/performance designed to make IBM more competitive with both systems manufacturers and peripheral equipment manufacturers. The Court finds that the document entitled "Listing of Manufacturers of Plug Compatible Products, The Products Offered and the Systems Manufacturers for Whose Systems the Products are Offered" (attached to "IBM's Response to Some of Telex's Proposed Findings of Fact and Conclusions of Law Relating to Telex's Antitrust Claims" dated June 15, 1973) is a summary of the details there stated.

Finding F67 is amended by adding following the chart on page 53, the following:

> The following four charts accurately reflect the information set forth. In the following four charts the figures following "user owned" and "leasing company" refer to devices initially manufactured by IBM. In the preceding chart the devices listed under "IBM" include IBM manufactured devices whether owned by IBM, owned by end-users or owned by leasing companies:

3D GENERATION 240X AND 2420 TYPE TAPE DRIVES FOR IBM SYSTEMS UNITS AND PERCENTAGE

	December 1970	June 1971	December 1971	June 1972	December 1973
240X type:					
IBM owned	20,182(59.8)	18,045(55.4)	15,859(52.3)	10,771(43.6)	5,996(30)
User owned	3,900(11.6)	4,057(12.4)	4,369(14.4)	4,656(18.8)	5,035(25)
Leasing company	5,554(16.5)	5,565(17.1)	5,405(17.8)	5,236(21.2)	4,911(25)
Peripheral company	4,088(12.1)	4,919(15.1)	4,705(15.5)	4,059(16.4)	3,602(18)
Total	33,724	32,587	30,338	24,722	19,544
2420 type:					
IBM owned	6,744(94.1)	7,695(87.2)	7,319(82.0)	3,698(67.7)	1,290(43)
User owned	304(4.2)	332(3.8)	344(3.9)	367(6.7)	384(13)
Leasing company	42(0.6)	46(0.5)	46(0.5)	38(0.7)	26(0)
Peripheral company	81(1.1)	749(8.5)	1,216(13.6)	1,361(24.9)	1,213(42)
Total	7,171	8,822	8,925	5,464	2,963
Total 240X-2420 type tapes:					
IBM owned	26,926(65.8)	25,740(62.2)	23,718(59.0)	14,469(47.9)	7,286(32)
User owned	4,204(10.3)	4,390(10.6)	4,713(12.0)	5,023(16.6)	5,419(24)
Leasing company	5,596(13.8)	5,611(13.5)	5,451(13.9)	5,274(17.5)	4,937(21)
Peripheral company	4,169(10.2)	5,668(13.7)	5,921(15.1)	5,420(18.0)	4,865(21)
Total	40,895	41,409	39,263	30,186	22.507

3420-TYPE TAPE DRIVES FOR IBM SYSTEMS UNITS AND PERCENTAGE

	December 1970	June 1971	December 1971	June 1972	December 1972
IBM owned	0	0	2,937(95.7)	12,845(92.6)	20,990(87.4)
User owned-IBM	0	1(100)	124(4.0)	320(2.3)	881(3.7)
Leasing company-IBM	0	0	0	13(0.1)	57(.2)
Peripheral company	0	0	10(.3)	696(5.0)	2,067(8.7)
Total	0	1	3,071	13,874	24,015

3D GENERATION, 2311-2314-2319 TYPE DISK SPINDLES FOR IBM SYSTEMS UNITS AND PERCENTAGES

	December 1970	June 1971	December 1971	June 1972	December 1972
2311 Type:					
IBM owned	10,712(51.4)	8,196(43.7)	6,464(38.0)	5,343(33.5)	4,326(29.0)
User owned	3,426(16.5)	3,507(18.6)	3,662(21.5)	3,838(24.1)	4,016(26.9)
Leasing company	4,497(21.6)	4,499(24.0)	4,348(25.5)	4,200(26.3)	4,035(27.1)
Peripheral company	2,194(10.5)	2,569(13.7)	2,576(15.0)	2,572(16.1)	2,536(17.0)
Total	20,829	18,771	17,050	15,953	14,913
2314-2319 Type:					
IBM owned	33,991(66.4)	32,552(58.6)	33,865(57.5)	30,656(53.3)	27,066(49.4)
User owned	7,009(14.1)	7,709(13.9)	8,124(13.8)	8,493(14.7)	9,326(17.0)
Leasing company	7,051(14.2)	7,109(12.8)	7,135(12.1)	7,018(12.2)	6,595(12.0)
Peripheral company	2,639(5.3)	8,179(14.7)	9,826(16.6)	11,395(19.8)	11,824(21.6)
Total	49,690	55,549	58,950	57,562	54,811
Total 2311 and 2314/2319 type spindles:					
IBM owned	43,703(62.0)	40,748(54.8)	40,329(53.1)	35,999(49.0)	31,392(45.0)
User owned	10,435(14.8)	11,216(15.1)	11,786(15.5)	12,331(16.8)	13,342(19.1)
Leasing company	11,548(16.4)	11,608(15.6)	11,483(15.1)	11,218(15.2)	10,630(15.1)
Peripheral company	4,833(6.8)	10,748(14.5)	12,402(16.3)	13,967(19.0)	14,360(20.6)
Total	70,519	74,320	76,000	73,515	69,724

3330-TYPE DISK SPINDLES FOR IBM SYSTEMS UNITS AND PERCENTAGE

	December 1970	June 1971	December 1971	June 1972	December 1972
IBM owned	0	0	2,400(86.1)	6,412(90.6)	11,518(90.5)
User owned—IBM	0	2(100)	374(13.4)	606(8.6)	972(7.6)
Leasing company—IBM	0	0	14(0.5)	56(0.8)	148(1.2)
Peripheral company	0	0	0	0	85(0.7)
Total	0	2	2,788	7,074	12,723

Finding F71 is amended by substituting the following for the last sentence.

This concern was intensified in January of 1970 when IBM learned that the Bureau of the Budget intended to encourage federal agencies to use equivalent lower cost peripheral equipment compatible with CPU's supplied by IBM and by other systems manufacturers and suggested the utilization of standard interfaces.

Finding F72 is amended by adding after the last sentence thereof the following:

Product superiority was achieved by Telex because these products were first delivered substantially later than the IBM products. The Telex 5314 and the Telex 5328 which is the controller for the Telex 5314 were purchased from Itel and were developed for Itel by a group of 12 former IBM personnel. The following table shows when IBM first announced and delivered the products and when Telex first announced and delivered the products it intended to replace the IBM product:

CHRONOLOGY OF PRODUCT INTRODUCTIONS

Telex product	Telex announcement date	Telex 1st customer shipment	IBM product	IBM announcement date	IBM 1st customer shipment
4700 tape drive	May 1966	August 1966	729 tape drive	January 1957	August 1958.
4800 tape drive	July 1967	March 1968	2401 tape drive	April 1964	May 1965.
5311 disk drive	May 1969	August 1969	2311 disk drive	do	February 1965.
5314 disk drive and controller.	do	April 1970	2314 disk drive and controller.	April 1965	March 1967.
5420 (model 7) tape drive.	May 1970	December 1970	2420 (model 7) tape drive.	January 1968	December 1968.
5420 (model 5) tape drive.	August 1970	February 1971	2420 (model 5) tape drive.	December 1968	October 1969.
6420/6803 tape drive and controller.	December 1970	November 1971	3420/3803 tape drive and contrller.	November 1970	September 1971.
5403/5821 printer and controller.	November 1970	August 1971	1403N1/2821 printer and controller.	April 1964	June 1965.
6360 memory	November 1971	November 1972	3360 memory	June 1970	February 1971.
6330/6830 disk drive and controller.	do	October 1972	333/3830 disk drive and controler.	do	August 1971.
6345 memory	do	Not yet delivered.	3345 memory	September 1970	November 1973.
6721 printer system	August 1972	do	1403N1/2821 (model 2) printer and controller.	April 1964	June 1965.

Finding F88 is amended to add after the last sentence thereof the following:

In view of the fact that most of IBM's systems manufacturer leasing company and peripheral equipment manufacturer competitors were offering long term leases by the Spring of 1971 (Finding F100), IBM expected to, and was likely to, continue to lose substantial systems and peripheral business unless some plan was adopted.

Following finding F89, the court makes as finding F89a, the following:

F89a. In 1970 and 1971 IBM experienced the effects of a nationwide recession combined with inflation, which caused a substantial increase in the level of returns and discontinuances of its EDP equipment including peripheral equipment. IBM at that time offered equipment only on short-term leases or for sale; its rental customers could effectively return their equipment to IBM on 30 days' notice. As a result of the economy, many of IBM's rental customers took advantage of this privilege and returned a significant amount of equipment to IBM. IBM's experience was not shared by its leasing company, systems manufacturer or peripheral equipment manufacturer competitors, since their equipment was generally leased for terms of one, two or more years, with termination charges or other costs in the event of cancellation. Another factor affecting IBM's business in this period was the increasingly lower rental prices charged by leasing companies and peripheral equipment manufacturers for equipment similar to IBM's. As a consequence of these factors, IBM's sales force in 1970 achieved only 50% of its selling objective. In 1971, IBM experienced the worst sales record year in its history for EDP equipment.

Finding F95 is amended by substituting the word "some" for the word "many" in the last sentence thereof.

Following finding F95 the court makes as finding F95a, the following:

F95a. Between 1968 and 1972, Telex had a number of products which competed with IBM products. There were many price changes and price variations during this period. All of those Telex products were at all points in time listed at lower prices than comparable IBM products except on four isolated occasions. Telex's prices were generally higher than the prices of other plug compatible manufacturers. In addition, Telex and the other plug-compatible manufacturers generally reduced below list the prices they actually charged through various forms of price concessions.

Finding F96 is amended to add in the ninth sentence in place of the words ". . . 28.7% of the plug compatible disk market . . .", the following:

28.7% of the 2314/2319 plug-compatible disk installations,
48% of the 3330 plug-compatible disk installations,

and the remainder of the sentence should remain as it now is.

Finding F97 is amended by substituting the term "360" for the term "350" in the second sentence thereof.

Finding F100 is amended by adding at the end of the fourth sentence thereof the following phrase:

with cancellation penalty clauses or with no cancellation option at all.

Finding F106 is amended by substituting the word "Mallard" for the word "Merlin" in the fourth sentence thereof.

Following finding F111, the court makes as Finding F111a the following:

F111a. There was no evidence that IBM reduced prices below cost and a reasonable profit. Indeed, when announced the profitability of the 2319 disk storage units, the 370/158 and 168 CPU's and CPU memory elements were anticipated to be in excess of 20%. Likewise, at the announcement of FTP it was anticipated that the profitability of the products to which it applied would be at least 20%. Those profit margins in part, of course, would have been achieved by obtaining leases of products which would have otherwise been made by Telex and other PCM's. Those price reductions are found to be predatory.

The fifth sentence of finding F116 is amended to replace the phrase ". . . publicity over IBM's accounting methods . . ." with the phrase ". . . publicity over Telex's accounting methods . . ."

Finding F121 is amended by changing the period at the end thereof to a comma and by adding "subject to the adjustments made in F124 with respect to the net antitrust damages to be awarded in favor of Telex."

Finding F122 is amended by adding at the end thereof:

These findings are subject to the adjustments made in F124 with respect to the net antitrust damage to be awarded in favor of Telex.

Finding F123 is amended to add at the end of that paragraph the following:

These findings are subject to the adjustments made in F124 with respect to the net antitrust damage to be awarded in favor of Telex.

Finding F124 is amended to read as follows:

F124. Accordingly the court finds that as a proximate result of IBM's unlawful acts and conduct the plaintiffs have suffered actual damages totaling $117.5 million, subject to the following adjustments: (a) An adjustment of $6 million representing by fair approximation the corrective or diminishing effect of the injunctive relief granted against IBM upon the damages that would be otherwise recoverable.* (b) unjust enrichment and damage items included in the judgment against Telex on IBM's first counterclaim for trade secret violation in the sum of $17.5 million which represents the best available quantification of the com-

*Plaintiffs contend in effect that any such offset would be speculative; that lost placements because of IBM's unlawful actions cannot be retrieved; that the curative effect of pricing provisions as to past impact are minimal within the period of allowed damages; that the injunctive relief does not restore the predatory price cuts, withdraw the prior effect of the FTP lockout nor negate their continuing effect to a measurable extent; that the already protracted delay in progressively building up its projected and formerly realistic market share as a result of IBM's suppression cannot now be made up; that the prohibition of future unlawful manipulation of prices or such lockout cannot reverse the effect of the past actions in view of lead time, and building, manufacturing, financing and other problems attributable to IBM's conduct and already effective, and that the results of the injunction, as important as they may be, will be large long range relating to future products not yet marketed by either IBM or Telex. The court already has limited the effect of plaintiffs' future market projections in determining damages to further minimize the bearing of the injunctive relief upon damages awarded. Yet upon consideration of the post-judgment motions I have found that that there will be an appreciable effect by the injunctive relief in reudction of actual damages otherwise recoverable, as above determined.

petitive advantage unlawfully obtained by Telex in establishing the market position upon the basis of which antitrust damages were in part determined by the court and which should be deducted from otherwise allowable antitrust damages before trebling; and (c) the additional sum of $7.5 million representing by fair approximation additional unlawful competitive advantage secured by Telex through misappropriation of IBM trade secrets, this being a judgmatical factor not quantified in the direct proof or findings on the trade secret counterclaim but not otherwise taken into account in my determination of actual antitrust damages. Accordingly, after deducting these factors and in view of all of the other circumstances heretofore considered by the court as reasonably bearing upon plaintiffs' damages, it is found that $86.5 million represents a fair and reasonable approximation of plaintiffs' actual antitrust damage proximately caused by the unlawful conduct of defendant as herein found.

Findings F126, F127, F128, F129, F130, are amended to read as follows:

F126. IBM should be enjoined for a period of three years from the date of this judgment from entering into or enforcing any contractually specified termination charges or liquidated damages which it otherwise might be entitled to collect because of termination of any long term lease agreement entered into between IBM and any of its end-user customers, with respect to IBM EDP peripheral products that are cable connected to any IBM CPU or its channel.

F127. IBM should be enjoined and required in good faith to make available on request, at the time of first customer shipment of an IBM CPU or its channel, information describing the design of the electronic interface for such product (including the details necessary to describe the characteristics, timing and sequencing of all signals to be interchanged, together with the function of such signals and the expected response to such signals transferred at the interface between such IBM CPU or its channel and the EDP peripheral products cable connected to it) and, in the event that a subsequently shipped IBM EDP peripheral product changes that interface, IBM should be required to make changes in the above information available at the time such product is shipped.*

F128. IBM should be enjoined and required to continue to price separately those System 370 memories which are not a single product with the central processing unit.**

F129. IBM should be enjoined and required to price separately its separate EDP products, including but not limited to CPU's, memories (as set forth in paragraph F128), tape products and their controllers, disk products and their controllers, printer products and their controllers and communication controllers.

F130. Where it offers a separate EDP peripheral product cable connected to an IBM CPU or channel in a separate box and a substantially equivalent version made from substantially common parts integrated into another product, IBM should be enjoined and required to continue to price the integrated version separately from the product into which it is integrated, and should be further enjoined and required to make a good faith effort to set its prices for both such versions with a substantially equivalent profit objective, and with cost and profit objectives being measured on an equivalent basis.

There is hereby added immediately following paragraph F130 as so amended, the following:

F130a. Neither paragraph F128, F129 nor F130 hereof is intended to require the separate pricing of anything which would not be regarded as a separate product pursuant to Section 3 of the Clayton Act and provided further in this connection that the court does not intend to inhibit technological changes which may alter the definition of what today may be a separate product.

F130b. IBM should be enjoined from adopting, implementing or carrying out predatory pricing, leasing or other acts, practices or strategies with

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*The parties and the Court shall use, as an aid in construction of this provision, the IBM Manual GA 22–6794–1: IBM System/360 and System/370 I/O Interface Channel to Control Unit Original Equipment Manufacturers' Infofmation.

***See* Findings 110, 111 and Conclusion 31.

intent to obtain or maintain an illegal monopoly in a relevant market for EDP peripheral equipment plug compatible to its CPU's, or any relevant submarkets thereof, in violation of Section 2 of the Sherman Act.

F130c. The foregoing injunctions are intended to be effective only within the United States. They and any changes, modifications or amendments thereof, should be enforced, construed or considered only upon motion duly made by The Telex Corporation, Telex Computer Products, Inc., or International Business Machines Corporation, or their successors in interest, and such motions should be made on at least twenty days' written notice.

Except as hereinabove provided, all motions to correct, amend or alter the findings of fact hereinbefore filed are hereby denied.

Dated this 9th day of November, 1973.

A. SHERMAN CHRISTENSEN,
Senior U.S. District Judge (*Assigned*).

[Filed Nov. 10, 1973]

In the United States District Court for the Northern District of Oklahoma

No. 72–C–18; No. 72–C–89 (Consolidated)

THE TELEX CORPORATION AND TELEX COMPUTER PRODUCTS, INC., PLAINTIFFS,

v.

INTERNATIONAL BUSINESS MACHINES CORP., DEFENDANT.

AMENDMENTS TO CONCLUSIONS OF LAW

Upon the defendant's timely motion to amend conclusions of law with reference to antitrust damages and injunctive relief, and the matters having been argued and submitted to the court for decision, it is now hereby ordered that the conclusions of law filed on September 17, 1973, be and they are hereby amended as follows:

The heading "Conclusions of Law; Discussion" on page 155 is amended to read "Amended Conclusions of Law; Discussion."

The following paragraphs C40(a) to (d), beginning at page 198 of said conclusions, are hereby added:

C40(a). Damage adjustments have been made as indicated in finding F124 with respect to the probable effect of injunctive relief, and the unlawful competitive advantages secured by Telex through misappropriation of IBM trade secrets. With reference to the first mentioned factor reducing actual damages by $6 million there need be added here only my conclusion that such authorities as United States v. Oregon State Medical Soc., 343 U.S. 325 (1952), and Florists' Nationwide Tel. Del. Net. v. Florists' Tel. Del. Ass'n., 371 F. 2d 263 (1967), relied upon by plaintiffs in an attempt to establish that no adjustment at all should be made for possible effects of the injunction, are not in point. Further discussion, however, seems necessary concerning adjustments based upon the effect of my trade secret counterclaim findings against Telex upon the determination of the antitrust damages against IBM. This aspect involves more complicated factual and legal problems to add to the array which already has characterized this unusual suit.

C40(b). I have, as in the findings indicated, deducted from the plaintiff's damages found before trebling the amount of $17.5 million fixed in my findings on IBM's first counterclaim to be the damages and unjust enrichment caused or enjoyed by plaintiffs as a result of the unlawful misappropriation of defendant's trade secrets [1] (not including, however, cost of increased security, additional cost of manufacturing the IBM head arm, and punitive damages which have little or no relationship to the subject under discussion). Initially I was, and plaintiffs continue to be, of the view that the subject matter of the first counterclaim and

[1] The items totaling this amount really constitute the only types of quantification of competitive advantage accruing from trade secret misappropriations which IBM suggested at the trial. While this quantification was not then attempted precisely for our present purpose it represents the best figure available in the evidence and I have concluded that it should be used in this connection.

the remedies thereon awarded in the nature of involuntary royalty were independent of the antitrust damages and should simply be set off against them after the latter were trebled, in view of Perma Life Mufflers, Inc. v. International Parts Corp., 392 U.S. 134 (1968), and Kiefer-Stewart Co. v. Joseph E. Seagram & Sons, 340 U.S. 211 (1951). However, I have concluded that this was error, since plaintiffs' prospective market position to the extent it otherwise would have been recognized in my antitrust damage calculations would have included such competitive advantage and should be adjusted accordingly before plaintiffs' damages are trebled. Other authorities relied upon by plaintiffs to the contrary are inapposite. See Semke v. Enid Automobile Dealers, 456 F. 2d 1361 (10th Cir. 1972), see also, 320 F. Supp. 445, 446–447 (W.D. Okla. 1970) ; Flintkote Company v. Lysfjord, 246 F. 2d 368 (9th Cir.), *cert. denied*, 355 U.S. 835 (1957) ; Bal Theatre Corp. v. Paramount Dist. Corp., 206 F. Supp. 708 (N.D. Cal. 1962) ; Waters v. Turner, 76 F. Supp. 279 (E.D. Pa. 1948) ; Sampson v. Thomas, 76 F. Supp. 691 (E.D. Mich. 1948) ; and Jerard Associates, Inc. v. The Stanley Works, 1966 Trade Cas. ¶ 71,820 (D.C.S.D. N.Y. 1966). In these cases the counterclaim or offset amounts were not, as here, directly connected with the evaluation of primary damages. In other contexts, I would agree that there is no justification in law or justice for the treble damage provision of the antitrust laws to be emasculated by artificially trebling a defendant's counterclaim. But damages cannot be recovered for detriment not based upon the violation of legal rights. Keogh v. Chicago & Northwestern Ry., 260 U.S. 156 (1922) ; Okefenokee Rural Electric Membership Corp. v. Florida Power & Light Co., 214 F. 2d 413, 418 (5th Cir. 1954) ; Maltz v. Sax, 134 F. 2d 2 (7th Cir.), *cert. denied*, 319 U.S. 772 (1943) ; Calnetics Corp. v. Volkswagen of America, Inc., 348 F. Supp. 623 (C.D. Cal. 1972) ; Jones Knitting Corp. v. Morgan, 244 F. Supp. 235, 239 (E.D. Pa. 1965), *rev'd on other grounds*, 361 F. 2d 451 (3d Cir. 1966) ; Mason City Tent and Awning Co. v. Clapper, 144 F. Supp. 754, 770 (W.D. Mo. 1956). *See also*, Columbia Nitrogen Corp. v. Roysten Co., 451 F. 2d 3, 15–16 (4th Cir. 1971) ; *Semke, supra* at 1370.

C40(c). The application of this principle is relatively clean-cut in the cases cited. For example *Calnetics Corp.* involved a single identifiable factor to be eliminated from consideration. *Semke* dealt with enjoined sales. Involved in *Mason City Tent and Awning* was attempted recovery under the antitrust laws for loss of profits from adjudged patent infringements. The principle of these cases has been applied in the complicated setting of the present one through the counterclaim deduction from antitrust damages before trebling to the extent above specified. I have found that there should be deducted also $7.5 million on an analogous theory, representing by fair approximation the additional effect of trade secret advantages not quantified in connection with IBM's counterclaim, not heretofore otherwise taken into account and which unless deducted would distort the antitrust damage determination made by the court. Concededly this is a judgmental process based upon a broad evaluation of the evidence.[2] But I cannot escape the conviction in review of the antitrust damages as a result of motions directed to the original judgment that account must be taken of this additional factor to the extent indicated. Plainiffs' contention that this re-evaluation is mere speculation in view of the drastic revision already made to their damage projections is rejected, for my evaluation has extended to a reconciliation of the two aspects in light of the evidence as I have viewed it. Much less am I persuaded, as argued by IBM, that these adjusting factors should be extended to swallow up all antitrust damages to which plaintiffs might otherwise be entitled. In effect IBM would extrapolate from each confidential document, subject, plan or employment, without proof or justification in the court's findings, dire consequences to its own business and unlimited advantage to Telex. I cannot accept the thesis, inferentially though not expressly advanced, that because of

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[2] It is hoped that no apology need be made for resorting to human judgment despite rather complete envelopment by a computer climate. In post-judgment briefs on quantification problems submitted to it each side seemingly has been able to support its position with a myriad of figures precisely allocated among a wide range of EDP devices, presumably with the aid of the ubiquitous machines. Nonetheless, the prior experiences of both parties, as documented in my findings, may raise some question concerning the infallibility of such processes. IBM's computers taught with little question that its anticompetitive stratagems would be effective in suppression of its plug compatible competition but the judgmental test of the extent to which this properly could be accomplished was represented neither in their input nor output. And Telex's lead time advantage by utilization of IBM's Aspen secrets likely could be computerized quantitatively but not qualitatively. Reversing the process, IBM's utilization of the court's qualitative findings cumulatively of "massive" trade secret penetration by Telex to treat each part or fragment as "massive" and to quantify it as such, is unjustified by the record.

the misappropriation of some of its trade secrets, however unjustified or impressive in aggregate, but yet limited in relation to Telex's total business and prospects, IBM became in effect almost the virtual owner of Telex's future despite its victimination by IBM's antitrust strategies. Such an argument in its full reach indeed would do violence to the principle of *Perma Life* and involve a domination of employment, technology and ideas in the EDP industry far beyond anything suggested by the evidence.[3] Moreover, its acceptance would tend to unduly extend if not pervert the state law of trade secrets in the defeat of federal antitrust policy. *Cf.* Sears, Roebuck & Co. v. Stiffel Company, 376 U.S. 225 (1964); Lear Inc. v. Adkins, 395 U.S. 653 (1969); Kewanee Oil Company v. Bicron Corporation, 478 F. 2d 1074 (6th Cir. 1973). Plaintiffs, as indicated in the findings, has the right to employ the skill, competitive aggressiveness, knowhow, ambition, foresight and planning together with all of the other talents and information of numerous experts hired from other EDP companies, as well as from IBM, and to utilize these to the fullest extent, short of illegal trade secret misappropriations.

C40(d). The final related point which seems to require comment is plaintiffs' contention that if counterclaim components are credited against the antitrust damages, they should be eliminated from the counterclaim. I cannot agree. Plaintiffs are entitled only to their proper antitrust damages. By the court's eliminating elements from the antitrust damage determination which should not have been included in the first place defendant is rendered no less entitled to the damages to which it has been awarded on its counterclaim. Certainly this would be true as to the elements not included in the adjustment, *i.e.*, security, extra manufacturing costs and punitive damages. The additional amounts have not been credited against plaintiffs' antitrust award but rather such award has been fairly fixed in view of them to the best of the court's ability. Assuming that I am right in this view, if Telex collects the present antitrust damage award it will have as much as it is entitled to, even though required to pay or offset the counterclaim. If the counterclaim award should be reversed, an adustment upward may have to be made in the antitrust award. If the antitrust award does not survive appeal and the trade secret award does, Telex should pay the latter, unless it becomes involved to the contrary in antitrust damage problems surviving appeal.

Change C41 beginning on page numbered 198 to read as follows:

The court accordingly concludes within the perimeter of the proof that Telex and Telex Computer Corporation have sustained damages to their business as a proximate result of defendant's violations of Section 2 of the Sherman Act in

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[3] The latest evaluation by the defendant of the effect of trade secret misappropriations seems somewhat an afterthought. No trade secret misappropriation counterclaim was actually pleaded until almost a year after plaintiffs filed their antitrust action against IBM. At a pre-trial hearing, in denying plaintiffs' motion to sever the counterclaim, the court did recognize that in the antitrust phase of the case it would be improper "to draw an iron curtain over their [trade secret misappropriations] exploration, with regard to damages, perhaps with regard to impact and probably with regard to other elements of liability . . ." IBM's amended answer, in twelve pages of denials and averments, contained only one express reference to Telex's violation of its trade secrets, ". . . that Telex has hired, and is continuing to hire, former IBM employees to obtain IBM confidential and proprietary information from such former IBM employees and from others and has thereby copied IBM tape, disk, printer and memory and storage devices and has announced such copies. Its trade secret counterclaim was pleaded as independent of its answer to the plaintiffs' antitrust charges. The court has found in the transcript no evidence offered by IBM as a part of its defense to the antitrust claims directly addressing itself to the quantification of any trade secret misappropriations as against plaintiffs' damages nor, indeed, did defendant's counsel cross-examine the principal witness presenting plaintiffs' damage projections with reference to the relationship itself. The only express mention that I have been able to find in IBM's final argument as to some possible relationship between antitrust damages and the subject matter of the counterclaim is when counsel began his discussion of the counterclaim and said: "Now, Your Honor, I want to turn to the last part, which will be mixed together somewhat: The injury, damages and counterclaim. As a prelude to that let me state a brief chronology . . ." And later counsel added: "Mr. Jatras testified that he believed they were going to the moon; and Telex's business success or failure was hinged entirely upon these products which it had set out to copy from IBM." (As I have pointed out in the findings, there is nothing improper in itself about copying unpatented products, and indeed that is an important part of competition in the industry.) Thereafter the quantification of counterclaim damage argued and requested by IBM had little or no bearing upon the pervasive effects of trade secret misappropriation now urged, nor any reference to types of counterclaim damage essentially different than those already allowed. The court awarded with some modification in amounts, for reasons stated, trade secret damages precisely on the theory defendant requested them in its proposed findings. It would not be fair to attempt to hold IBM to a waiver of its present broader contentions, but this note may serve to put them in more realistic perspective.

the amount of $86.5 million which amount must be trebled as required by law; and the plaintiffs therefore are entitled to judgment against IBM in the total amount of $259.5 million, plus attorneys' fees of $1.2 million, which the court finds to be reasonable, and for costs in accordance with the stipulation already of record. It is believed and found that any greater amount, although supported by some evidence, would be speculative and not supported by preponderant evidence applying the rule of liberality enjoined by the authorities. Weighing all relevant factors it is believed that any less amount would be contrary to the preponderance of the evidence and accordingly also a miscarriage of justice.

Paragraph C43 beginning on page numbered 200 is amended to read as follows:

Applying the established principles of these cases to the facts found, and in reasonable relief to the plaintiffs and protection to the public, but without unnecessary interference with technological developments in the industry, the decree herein should contain the following equitable remedies on the plaintiffs' antitrust claims:

(a) IBM should be enjoined for a period of three years from the date of this judgment from entering into or enforcing any contractually specified termination charges or liquidated damages which it otherwise might be entitled to collect because of termination of any long term lease agreement entered into between IBM and any of its end-user customers, with respect to IBM EDP peripheral products that are cable connected to any IBM CPU or its channel.

(b) IBM should be enjoined and required in good faith to make available on request, at the time of first customer shipment of an IBM CPU or its channel, information describing the design of the electronic interface for such product (including the details necessary to describe the characteristics, timing and sequencing of all signals to be interchanged, together with the function of such signals and the expected response to such signals transferred at the interface between such IBM CPU or its channel and the EDP peripheral products cable connected to it) and, in the event that a subsequently shipped IBM EDP peripheral product changes that interface, IBM should be required to make changes in the above information available at the time such product is shipped.[4]

(c) IBM should be enjoined and required to continue to price separately those System 370 memories which are not a single product with the central processing unit.[5]

(d) IBM should be enjoined and required to price separately its separate EDP products, including but not limited to CPU's, memories (as set forth in paragraph (c)), tape products and their controllers, disk products and their controllers, printer products and their controllers and communication controllers.

(e) Where it offers a separate EDP peripheral product cable connected to an IBM CPU or channel in a separate box and a substantially equivalent version made from substantially common parts integrated into another product, IBM should be enjoined and required to continue to price the integrated version separately from the product into which it is integrated, and should be further enjoined and required to make a good faith effort to set its prices for both such versions with a substantially equivalent profit objective, and with cost and profit objectives being measured on an equivalent basis.

(f) Neither paragraph (c), (d) nor (e) hereof is intended to require the separate pricing of anything which would not be regarded as a separate product pursuant to Section 3 of the Clayton Act and provided further in this connection that the court does not intend to inhibit technological changes which may alter the definition of what today may be a separate product.

(g) IBM should be enjoined from adopting, implementing or carrying out predatory pricing, leasing or other acts, practices or strategies with intent to obtain or maintain an illegal monopoly in a relevant market for EDP peripheral equipment being campatible to its CPU's, or any relevant submarkets thereof, in violation of Section 2 of the Sherman Act.

(h) The foregoing injunctions are intended to be effective only within the United States. They and any changes, modifications or amendments thereof should be enforced, construed or considered only upon motion duly made by The Telex Corporation, Telex Computer Products, Inc., or International Business Machines Corporation, or their successors in interest, and such motions should be made on at least twenty days' written notice.

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[4] The parties and the Court shall use, as an aid in construction of this provision, the IBM Manual GA 22–6794–1; IBM System/360 and System/370 I/O Interface Channel to Control Unit Original Equipment Manufacturers' Information.

[5] *See* Findings 110, 111 and Conclusion 31.

(i) The court should decline to order either the public disclosure by IBM of all planned or anticipated product enhancements, or the divestiture of IBM's holdings, for the reasons more fully developed in the findings.

Paragraph C59(a) beginning on page numbered 216 is amended to read as follows:

(a) Statutory damages for copyright violation in the amount of $13,776, together with attorney's fees in the sum of $3,000, which the court finds to be reasonable.

Except as hereinabove provided and as reflected and provided in the amended judgment and decree file herewith, all motions to correct, amend or alter the conclusions of law and judgment and decree or for a new trial as hereinbefore filed are hereby denied.

Dated this 9th day of November, 1973.

A. SHERMAN CHRISTENSEN,
Senior United States District Judge (Assigned).

[Filed Nov. 10, 1973]

In the United States District Court for the Northern District of Oklahoma

No. 72–C–18; No. 72–C–89 (Consolidated)

THE TELEX CORPORATION AND TELEX COMPUTER PRODUCTS, INC., PLAINTIFFS,

v.

INTERNATIONAL BUSINESS MACHINES CORPORATION, DEFENDANT.

AMENDED JUDGMENT AND DECREE

The issues having been duly tried to the court, findings of fact, conclusions of law and judgment and decree having been filed and entered on September 17, 1973, timely motions to amend such findings of fact, conclusions of law and judgment and decree having been filed, argued and considered by the court, and the court having made certain amendments and supplements to its findings of fact and conclusions of law; now, accordingly,

It is hereby ordered, adjudged and decreed:

1. That plaintiffs, The Telex Corporation and Telex Computer Products, Inc., have and recover judgment of and from the defendant International Business Machines Corporation in the sum of $259.5 million, after the found actual damages have been trebled as required by law, together with attorneys' fees in the sum of $1.2 million, and stipulated costs of court in accordance with the agreement of the parties heretofore entered on the record.

2. IBM is hereby enjoined for a period of three years from the date of this judgment from entering into or enforcing any contractually specified termination charges or liquidated damages which it otherwise might be entitled to collect because of termination of any long term lease agreement entered into between IBM and any of its end-user customers, wtih respect to IBM peripheral products that are cable connected to any IBM CPU or its channel.

3. IBM is enjoined and required in good faith to make available on request, at the time of first customer shipment of an IBM CPU or its channel, information describing the design of the electronic interface for such product (including the details necessary to describe the characteristics, timing and sequencing of all signals to be interchanged, together with the function of such signals and the expected response to such signals transferred at the interface between such IBM CPU or its channel and the EDP peripheral products cable conected to it) and, in the event that a subsequently shipped IBM EDP peripheral product changes that interface, IBM shall make changes in the above information available at the time such product is shipped.[1]

4. IBM is enjoined and required to continue to price separately those System 370 memories which are not a single product with the central processing unit.[2]

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[1] The parties and the Court shall use, as an aid in construction of this provision, the IBM Manual GA 22–6794–1: IBM System/360 and System/370 I/O Interface Channel to Control Unit Original Equipment Manufacturers' Information.

[2] *See* Findings 110, 111 and Conclusion 31.

5. IBM is enjoined and required to price separately its separate EDP products, including but not limited to CPU's, memories (as set forth in paragraph 4), tape products and their controllers, disk products and their controllers, printer products and their controllers, and communication controllers.

6. Where it offers a separate EDP peripheral product cable connected to an IBM CPU or channel in a separate box and a substantially equivalent version made from substantially common parts integrated into another product, IBM is enjoined and required to continue to price the integrated version separately from the product into which it is integrated, and is further enjoined and required to make a good faith effort to set its prices for both such versions with a substantially equivalent profit objective, and with cost and profit objectives being measured on an equivalent basis.

7. Neither paragraph 4, 5, nor 6 hereof is intended to require the separate pricing of anything which would not be regarded as a separate product pursuant to Section 3 of the Clayton Act and provided further in this connection that the court does not intend to inhibit technological changes which may alter the definition of what today may be a separate product.

8. IBM is enjoined from adopting, implementing or carrying out predatory pricing, leasing or other acts, practices or strategies with intent to obtain or maintain an illegal monopoly in a relevant market for EDP peripheral equipment plug compatible to its CPU's, or any relevant submarkets thereof, in violation of Section 2 of the Sherman Act.

9. The foregoing injunctions are intended to be effective only within the United States. They and any changes, modifications or amendments thereof may be enforced, construed or considered only upon motion duly made by The Telex Corporation, Telex Computer Products, Inc., or International Business Machines Corporation, or their successors in interest, and such motions shall be made on at least twenty days' written notice.

10. International Business Machines Corporation shall have and recover from Telex Corporation and Telex Computer Products Inc., the total sum of $21,913,-776, made up as by the conclusions of law shown, together with attorneys' fees for the adjudged copyright infringement in the sum of $3,000, and costs in accordance with the stipulation heretofore made of record.

11. The Telex Corporation and Telex Computer Products, Inc., are enjoined and required:

a. To return to IBM all IBM documents and all Telex documents containing IBM confidential information which are in Telex's custody or under its control, and to destroy all copies of Telex manuals under its control or in its custody which infringe IBM copyrighted manuals.

b. To refrain from hiring or soliciting any IBM employee for a period of two years without approval from the court.

c. To refrain from copying any IBM copyrighted materials.

d. To refrain from soliciting or using any IBM confidential or proprietary information.

e. To refrain from assigning any former IBM employee employed now or in the future by Telex to the development or manufacture of products functionally equivalent or similar to those on which such employee worked at IBM for a period of not less than two years following the termination of his employment with IBM.

12. Notwithstanding the undetermined claims relating to foreign markets, the court, pursuant to Rule 54(b) Fed. R. Civ. P., hereby determines that there is no just cause for delay in the entry of this judgment, and the Clerk is hereby directed to enter final judgment in accordance with the foregoing, subject to immediate appeal. A stay of execution is hereby granted subject to disposition of defendant's motion of September 26, 1973, pursuant to Rule 62(d) of the Federal Rules of Civil Procedure for an order suspending injunctive relief against defendant pending appeal or, in the alternative, for an order requiring plaintiffs to provide security in the amount deemed appropriate by the court, and subject to the disposition of other motions, if any, for stay or supersedeas in connection with an appeal of this judgment by any party.

13. Against the possibility that it should be determined that reserved claims with reference to foreign markets are not sufficiently separate as to permit the invocation of Rule 54(b), Fed. R. Civ. P., and that despite the provisions of 28 U.S.C. § 1292(a)(1) with reference to appeal of interlocutory injunctions, the antitrust and trade secret damage awards herein otherwise would not be subject to immediate appeal, the court hereby finds and states:

That it is its opinion that all of the provisions of the foregoing orders and judgment, including the question of antitrust and trade secret damages, as well as the injunctions, involve controlling question of law as to which there is substantial ground for differences of opinion, and that an immediate appeal from said orders and the foregoing judgment as a whole, and each part thereof, may materially advance the ultimate determination of this litigation; that the reserved claim as to foreign markets likely will involve questions concerning damages as well as injunctions the same as, or similar to, those which would be decided in an appellate review of the foregoing judgment, and that unless and until all such questions are decided on appeal from this judgment there likely would be great extra expense and the expenditure of extended time and effort in discovery concerning, and adjudication of, the foreign market claim much of which may be rendered either more certain and expeditious, or needless, if the foregoing judgment is reviewed in its entirety.

Dated this 9th day of November, 1973.

A. SHERMAN CHRISTENSEN,
Senior United States District Judge (Assigned).

District Court, D. Minnesota, Fourth Div.

HONEYWELL INC. v. SPERRY RAND CORPORATION ET AL.

No. 4–67 Civ. 138 Decided Oct. 19, 1973

PATENTS

1. Use and sale—Character of evidence to prove (§ 69.3)

In determining whether patentees' public use of invention was a nonexperimental public use, standard is fair preponderance of the evidence, not clear and satisfactory proof, clear and convincing proof, or proof beyond a reasonable doubt.

2. Use and sale—Extent and character of use (§ 69.5)

Uses were not excused as experimental where they were not under inventors' surveillance, and were not for purpose of enabling them to test machine and ascertain whether it would answer purpose intended and to make such alterations and improvements as experience demonstrates to be necessary.

3. Use and sale—In general (§ 69.1)

Burden of proof of exemption to public use bar, such as by reason of experimentation essential to completion of making or perfecting of invention by or for inventors, rests with patentees.

4. Applicants for patent—In general (§ 14.1)

Presumption from patent grant—Weight of (§ 55.9)

Patent is presumed to be valid and inventors named therein are presumed to be the true and actual inventors; alleged infringer has heavy burden to overcome presumption; to meet burden, it would have to be established that there were other inventors of subject matter of each patent claim.

5. Interference—Originality of invention—In general (§ 41.551)

Work, experiments, and suggestions of others, not rising to level of invention, in assisting inventors in carrying out conception do not entitle others to be treated as inventors or co-inventors.

6. Interference—Originality of invention—In general (§ 41.551)

Failure of alleged inventor or co-inventor to make a claim of inventorship at time named inventors were being publicized as the inventors is evidence permitting the inference that assertions of inventorship or co-inventorship are not sustainable.

7. Patentability—Anticipation—Publications—In general (§ 51.2271)

Fact of publication of article is evidenced by certificate of copyright registration which states the date of publication.

8. Specification—Sufficiency of disclosure (§ 62.7)

It is presumed that Patent Office reviewed patent application for sufficiency of its description and that patent's disclosure is sufficient to teach one skilled in the art how to practice the invention.

9. Specification—Sufficiency of disclosure (§ 62.7)

It is unnecessary that patent describe all possible embodiments of the invention.

10. Amendments to patent application—In general (§ 13.1)

Where applicant does not originally assert claims which are added later by amendment and subject matter of such late claims is disclosed or in general use and applicant stands by to await developments in the industry before asserting them, there is an unreasonable delay and neglect on applicant's part rendering late claims invalid.

11. Amendments to patent application—New matter (§ 13.5)

Where a late-filed amendment of specification is important enough to constitute basis for alleged patentability, amendment constitutes new matter and cannot in fact be a basis for patentability.

12. Amendments to patent application—In general (§ 13.1)

Patentee's long delay in adding broadened claims to application warrants inference that claims were added as an afterthought and not as a logical development of original application; claims are invalid where their subject matter was in public use more than year before they were first introduced.

13. Amendments to patent application—In general (§ 13.1)

Repeated entry into interferences, resulting in long delays incident to their determination, affords no execuse for failure to assert broader claims at an earlier date; long delay in coming to the point with new and broader or different claims strongly confirms that the final determination to do so was an exigent afterthought, rather than a logical development of original application.

14. Amendments to patent application—In general (§ 13.1)

Applicant cannot enlarge pending application so as to embrace and include for the first time the essential elements of an article, device, or structure which has been in public use or on sale more than one year prior thereto.

15. Amendments to patent application—In general (§ 13.1)

Courts regard with disfavor attempts to enlarge scope of application once filed, the effect of which would be to enable patentee to appropriate other inventions made prior to such alteration, or to appropriate that which has, in the meantime, gone into public use.

16. Laches—As to patent applications (§ 44.15)

Deliberately extending expiration of patent monopoly is violation of Constitution and patent laws; international delay by applicant invalidates patent; however, applicant may avail himself of all provisions of patent statutes.

17. Presumption from patent grant—Weight of (§ 55.9)

Rebuttable presumption of validity under 35 U.S.C. 282 is not accorded much weight.

18. Presumption from patent grant—Patent Office consideration of prior art (§ 55.5)

Statutory presumption of validity is weakened, if not destroyed, where bars to patentability raised in litigation are based on prior art or use not before Patent Office.

19. Defenses—Fraud (§ 30.05)

One practical reason for requirement of absolute honesty and good faith disclosure by applicant in ex parte Patent Office examination is that even an innocent misrepresentation of facts destroys presumption of validity.

20. Patentability—Anticipation—Prior knowledge, use or sale (§ 51.223)

Public use bar is based on fiat of Congress that it is part of consideration for a patent that public shall begin to enjoy the disclosure as soon as possible.

21. Use and sale—Extent and character of use (§ 69.5)

Use of invention by a person other than the inventor, not essential to completion of the making of the invention by the inventor, is a public use; fact that invention is buried within a machine is irrelevant.

22. Use and sale—Extent and character of use (§ 69.5)

Under limited conditions, where invention involves need for public use as the only practical way to test value of invention and thereby permit the making of the invention to be completed, inventor may experiment in public as an exception to public use bar; this exception does not apply where it is possible to experiment in private; it applies only where use is by inventor or persons under his control for purpose of perfecting invention.

23. Affidavits—Anticipating references (§ 12.3)
Use and sale—Extent and character of use (§ 69.5)

Patentee's Rule 131 affidavit asserting completion of invention in United States before filing date of application fixes the last possible date for experimental use.

24. Use and sale—Extent and character of use (§ 69.5)

Where there is no question of inventor's determination of whether invention worked or how it could be improved and where sole purpose of a demonstration is to show new developments in equipment, which have been proved operational, to the public, such use is public, not experimental.

25. Use and sale—Extent and character of use (§ 69.5)

Where idea of machine has been conceived and conception carried into effect by its construction, which machine is then used or capable of being used for designed purpose, such use is no longer an experiment.

26. Use and Sale—Extent and Character of Use (§ 69.5)

Fact that machine was not ultimately perfected at time it was first in use does not avoid a public use bar.

27. Patentability—Anticipation—Prior Knowledge, Use or Sale (§ 51.223)

Policy consideration behind public use doctrine is to stimulate reasonable disclosure of inventions.

28. Use and Sale—Extent and Character of Use (§ 69.5)

Single public use of patented machine more than year before patent application is filed, even without profit to inventor, establishes a public use bar.

29. Use and Sale—Extent and Character of Use (§ 69.5)

Public demonstration of device to members of the public including the press gives rise to a compelling inference that demonstration was a public use and not within experimental use exception.

30. Patentability—Anticipation—Prior Knowledge, Use or Sale (§ 51.223)

Complete identity of device in public use with device as claimed in patent is not necessary to establish public use bar; difference between devices must be a patentable one to avoid bar; inventor cannot avoid bar by establishing that device, which was installed and used, was imperfect.

31. Use and Sale—Sale (§ 69.8)

"On sale" does not mean an actual accomplished sale but merely activity by ventor in a commercial exploitation of what he later asserts the power to monopolize; express contract for construction of equipment embodying principles of invention may constitute "on sale" despite fact that no structure has been constructed; moreover, device need not be actually delivered, but only be ready for delivery; also, a device imperfect in a mechanical sense may be "on sale"; further, device may be "on sale" even if purchaser or offeree imposes a secrecy classification on it.

32. Use and Sale—Character of Evidence To Prove (§ 69.3)

Prima facie showing that invention was "on sale" can be overcome only by unequivocal and convincing evidence to the contrary.

33. Applicants for Patent—In General (§ 14.1)

Patent applied for by one who is not the inventor is void whether taken out in his name or name of his assignee.

34. Patentability—Evidence of—Solution by Several Parties (§ 51.465)

Utilization of ideas in device prior to time of alleged invention, whether or not device was abandoned, is evidence that, when ideas are incorporated in a later development along the same line, they do not amount to invention.

35. Patentability—Anticipation—Publications—What is Publication (§ 51.2277)

Reproduction of a description of invention by any copy-making technique capable of enabling wide dissemination of multiple copies evidences sufficient accessibility by public so as to constitute a "printed publication" within meaning of patent statute.

36. Patentability—Anticipation—Publications—In General (§ 51.2271)

Patent statute relating to printed publications is based upon public policy that, once an invention has been made accessible to public through printed publication, it cannot be withdrawn into a patent.

37. Patentability—Anticipation—Publications—What is Publication (§ 51.2277)

Description document qualifies as a printed publication even where only a single typewritten copy is put on file in college library, because it is the expression of intent that fruits of research be available to interested public that is determinative of fact of publication.

38. Patentability—Anticipation—Publications—What is Publication (§ 51.2277)

Distribution of small number of copies of a descriptive document to a limited group skilled in the art, who are outside distributor's organization, is publication within meaning of patent statute.

39. Laches—As to Patent Applications (§ 44.15)

Although not rendering patent invalid for deliberately extending expiration of its monopoly, consequences of delay in issuance of patent due to six years of inadequate preparation by patentee in interference litigation, and thereby the proceedings before Patent Office, render patent unenforceable.

40. Amendments to Patent Application—In General (§ 13.1)

Intentional delay in prosecution of patent application to enable changes in specification and claims so that work of other inventors might be covered renders patent invalid.

41. Patent Grant—Intent of Patent Laws (§ 50.15)

Since patent laws are founded on public policy to promote progress of science and useful arts, public is a material party to, and should be considered in, every application for patent; moreover, arts and sciences will not be promoted by encouraging inventors to withhold their invention, especially if they are brought forward at a later time to defeat other inventors who have placed benefit of their inventions within knowledge of public.

42. Defenses—Fraud (§ 30.05)

Applicant's misconduct before Patent Office, even if it was not material to procurement of patent, renders patent unenforceable; there is a line between willful and intentional fraud which invalidates patent and inequitable conduct which renders it unenforceable.

43. Misuse of Patents—In General (§ 45.01)

Claim for damages based on violation of antitrust laws because of willful and intentional fraud on Patent Office requires proof by clear and convincing evidence.

44. Defenses—Fraud (§ 30.05)

Patent applicants and parties to Patent Office proceedings have uncompromising duty to report to Office fully and fairly all facts which may affect patentability of invention; public interest demands that all such facts be submitted formally or informally to Office; fraud in procurement of patent includes not only intentional misrepresentations but also intentional concealment of material facts.

45. Defenses—Fraud (§ 30.05)

Although complete candor with and disclosure to Patent Office is required, what should be disclosed to Office as possible sources of invention, prior art, or derivation must in some degree be left to applicant's judgment and conscience.

46. Misuse of Patents—In General (§ 45.01)

To recover antitrust damages based on fraud in obtaining patent, plaintiff must prove (1) willful and intentional fraud, (2) injury to business or property caused by fraudulently procured patent, and (3) other elements necessary to violation of section 2 of Sherman Act; good faith or honest mistake is a complete defense; moreover, proof of fraud must be by clear, unequivocal, and convincing evidence, a mere preponderance of evidence being insufficient.

47. Misuse of Patents—In General (§ 45.01)

As part of action seeking antitrust damages based on fraud in obtaining patents, plaintiff has standing to assert claims based on defendant's ownership of patents which defendant has not claimed to have been infringed by plaintiff and on applications which defendant has not used as base for claim of royalties.

48. Use and Sale—Sale (§ 69.8)

Manufacturer put device on sale by turning it over to Government for acceptance testing.

49. Misuse of Patents—In General (§ 45.01)

One who has not yet been charged with infringing a patent may have standing as private attorney general to seek a declaration in antitrust action that it is invalid or unenforceable.

50. Interference—In General (§ 41.01)

Misuse of Patents—In General (§ 45.01)

Settlements of patent interferences are to be encouraged unless in the process the antitrust laws are violated and the public interest harmed.

51. Misuse of Patents—Exchange of Licenses or Patents (§ 45.25)

Nonexclusive patent cross-licensing in itself may be proper under antitrust laws.

52. Misuse of patents—In general (§ 45.01)

In order to sustain a finding of patent misuse or a Sherman Act violation based on discriminatory patent licensing, plaintiff must show at least (1) plaintiff took a license, (2) royalty rate charged plaintiff and that charged a competitor were unequal, (3) in all particulars relevant to equality of rates plaintiff and its licensed competitor were similarly situated, and (4) royalties were an important expense factor in production costs and discriminatory rate caused substantial impairment of competition in relevant market.

53. Misuse of patents—Defense to suit (§ 45.15)

Any possible impropriety on patentee's part in making its license offers was purged by placing of infringement action, with issue of appropriate royalties or infringement damages, before court.

54. Infringement—Tests of—Comparison with claim (§ 39.803)

In determining whether accused device infringes patent, resort must be had in the first instance to words of claim; if accused matter falls clearly within claim, infringement is made out.

Particular patents—Computer

3,120,606, Eckert and Mauchly, Electronic Numerical Integrator and Computer, invalid.

Action by Honeywell, Inc. against Sperry Rand Corporation and Illinois Scientific Developments, Inc., for violation of patent invalidity and noninfringement in which defendants. counterclaim for patent infringement. Judgment for plaintiff in part and for defendant in part.

Henry Halladay, Minneapolis, Minn., and D. D. Allegretti, Chicago, Ill., for plaintiff.

Frank Claybourne, St. Paul, Minn., and H. Francis DeLone, Philadelphia, Pa., for defendants.

Larson, District Judge.

Findings of Fact, Conclusions of Law and Order for Judgment

0. Introduction

0.1 This case is a consolidation of two actions which were commenced simultaneously on May 26, 1967 before this Court and the District Court for the District of Columbia:

Honeywell, Inc. v. Sperry Rand Corporation, U.S. District Court for the District of Minnesota. File No. 4–67 Civ. 138 (hereinafter the Minnesota action).

Illinois Scientific Developments, Inc. v. Honeywell, Inc., U.S. District Court for the District of Columbia, Civil Action No. 1373–67 (hereinafter the District of Columbia action).

0.1.1. Honeywell, Inc. (hereinafter Honeywell or plaintiff) is a Delaware corporation with its principal office and place of business in Minneapolis, Minnesota.

0.1.2. Sperry Rand Corporation (hereinafter SR) is a Delaware corporation with its principal office and place of business in New York, New York, and is authorized to do and does business in Minnesota.

0.1.3 Illinois Scientific Developments, Inc. (hereinafter ISD) is an Illinois corporation with its principal office and place of business at that of SR. ISD is a wholly owned subsidiary of SR.

0.1.4 Honeywell's Complaint in the Minnesota action as originally raised two cause of action:

.1 Count One charged SR with violation of Section 2 of the Sherman Act by reason of the maintenance and enforcement of an allegedly fraudulently procured patent (the so-called "ENIAC patent"). The ENIAC patent was alleged to have the exclusionary power to effectively dominate the entire electronic data processing industry. Injunctive relief and damages were sought.

.2 Count Two sought declaratory judgment of invalidity and unenforceability of the ENIAC patent for the antitrust misconduct complained of in Count One, and for failure to comply with the legal prerequisites of the Patent Statute.

0.1.5. ISD's Complaint in the District of Columbia action charged infringement by Honeywell of the ENIAC patent. Injunctive relief and damages were sought.

0.1.6 On March 5, 1968, the District of Columbia action was transferred to the District of Minnesota and consolidated by order of Judge Nordbye on May 1, 1968, with the Minnesota action as a counterclaim by ISD, which was realigned as a defendant.

0.1.7 on May 1, 1968, Honeywell filed its First Amended Complaint, in the consolidated action, adding expanded allegations that SR and ISD's conduct had violated Section 1 as well as Section 2 of the Sherman Act, and adding Count Three charging that the acquisition of the ENIAC patent was a violation of Section 7 of the Clayton Act.

0.1.8 On August 29, 1969, Honeywell filed its Second Amended Complaint, adding a paragraph 30A under which other patents and pending patent applications, in addition to the ENIAC patent, were alleged to be subject to the same infirmities as those with respect to the ENIAC patent, and their procurement, licensing, and attempted enforcement were alleged to constitute a further part of a pattern of conduct of defendants in restraint of trade in violation of the Sherman Act.

0.2 Based upon statements of claims as presented by the parties, the Court's pre-trial understanding of the issues to be tried was expressed to counsel for the parties at a hearing on July 1, 1970 to the following effect:

0.2.1 Honeywell claims that the basic issue as far as it is concerned is whether the activities of SR and ISD and their predecessors in obtaining, maintaining, and enforcing their EDP patent portfolio, including know-how, violate the antitrust laws particularly Sections1 and 2 of the Sherman Act and Section 7 of the Clayton Act.

0.2.2 Honeywell claims that SR and ISD engaged in illegal activities as follows:

.1 The fraudulent procurement and enforcement of ENIAC, EDVAC, and other patents and patent applications.

.2 The illegal acquisition of the ENIAC patent application.

.3 The use of the claimed illegal patent portfolio to induce IBM and BTL to give up meritorious attacks on the validity of the ENIAC patent and other of defendants' EDP patents.

.4 Irrespective of the ENIAC patent's validity, the entering into of a total cross-license of EDP patents and EDP know-how with IBM in 1956.

.5 The attempted enforcement of the ENIAC patent known by defendants to be subject to infirmities.

.6 Demanding discriminatory royalties for the ENIAC patent license.

0.2.3 Honeywell claims that if it prevails on any of the foregoing that it is then entitled to damages and injunctive relief.

0.2.4 Honeywell states further that if its allegations of conspiracy and combination in violation of the antitrust laws are not sustained, then certain subsidiary issues must be reached:

.1 Whether or not the ENIAC patent is valid under the technical aspects of the Patent Laws.

.2 If the ENIAC patent is technically valid, has Honeywell infringed.

.3 If infringement is proved, what damages has ISD sustained.

0.2.5 SR and ISD take the position that this is basically a lawsuit by ISD charging Honeywell with infringement of the ENIAC patent, and a suit by Honeywell against SR and ISD for a declaratory judgment that the ENIAC patent is invalid.

0.2.6 SR and ISD claim that Honeywell has admitted the infringemnet if the ENIAC patent is valid, but will nevertheless select a limited number of claims to litigate this question.

0.2.7 In response to the ENIAC patent infringement claim, SR and ISD claim that Honeywell has raised a number of affirmative defenses:

.1 Public use prior to the critical date of June 26, 1946.

.2 That Mauchly and Eckert were not the sole inventors of the ENIAC patent.

.3 Derivation from Dr. John V. Atanasoff.

.4 Fraudulent procurement.

.5 Fraudulent conduct to delay the issuance of the ENIAC patent.

0.2.8 With respect to the antitrust issues, SR and ISD claim that the issues relate to:

.1 Fraudulent procurement which has been raised by Honeywell as a defense, but has also been raised by Honeywell as an affirmative antitrust allegation.

.2 Discriminatory licensing by SR in making IBM its favored licensee.

.3 SR's acquisition of title to the ENIAC patent application alleged in Count Three of the Complaint in 1955, which Honeywell claims substantially lessened competition.

0.2.9 In response to the Count Three claim of Honewell's complaint, SR and ISD claim that a private party does not have standing under Section 7 of the Clayton Act, and also that the statute of limitations has run.

0.2.10 At the close of plaintiff's case, defendants moved to dismiss Counts One and Three of the Amended Complaint. The motion was denied as to Count One, but granted as to Count Three with entry of judgment stayed until final decision or otherwise ordered.

0.3 Pursuant to pretrial order on March 29, 1971, trial was set on the issues of liability under Honeywell's claims of antitrust violation and ISD's claim of patent infringement.

0.3.1 Pending determination of the issues of liability, Honeywell's testimony as to damages on its antitrust claims, and ISD's testimony as to patent infringement damages or accounting, were deferred.

0.3.2 Honeywell's evidence as to impact or injury was received in the trial on the liability issues.

0.4 Trial commenced before the Court without a jury on June 1, 1971 and continued with few interruptions until it closed on March 13, 1972, consuming over 135 days or parts of days. During this long course of trial, the Court heard and received extensive evidence. The statistics are impressive.

0.4.1 Seventy-seven witnesses presented oral testimony in the courtroom, and the testimony of an additional eighty witnesses was presented by deposition transcripts.

0.4.2 The Court's attention was directed to 25,686 exhibits marked by Honeywell as Plaintiff's Trial Exhibits (PX).

0.4.3 The Court's attention was directed to 6,968 exhibits marked by SR and ISD as Defendants' Trial Exhibits (DX).

0.4.4 Many of the exhibits were extremely voluminous, including both documents of great length and also collections of multiple documents designated as single exhibits. For example, PX-1 is a 496 page book describing the 19th century work of Charles Babbage relating to early digital computing, and DX-2 is a collection of documents relating to the ENIAC patent application, occupying a four-drawer legal filing cabinet; DX-1, the ENIAC patent itself, comprises 91 sheets of drawings and 232 columns of closely printed text.

0.4.5 About 500 additional exhibits were marked and referred to during the trial.

0.4.6 The trial transcript extends to over 20,667 pages.

0.5 The trial afforded the Court a comprehensive view of complex technical and economic evidence involving the electronic data processing industry and relevant history before and about automatic electronic digital computing and computers.

0.5.1 The Court was aided by extensie tutorial testimony and demonstrative exhibit presentations. The courtroom demonstrations included the copious use of charts, photographs, slides, physical devices, mechanical and electronic machines operated in the courtroom, and a movie film.

0.5.2 The Court had a view of both Honeywell and SR electronic data processing systems in computing operation at their respective Twin City facilities.

0.5.3 The Court had the assistance of explanatory courtroom testimony by knowledgeable fact and expert witnesses called by both parties in the course of the trial and in the presentation of demonstrative and physical exhibits.

0.5.4 The Court had the benefit of excellent and well documented briefs of both parties.

0.5.4.1 Pursuant to a pretrial conference held on July 1, 1970, the Court suggested and counsel adopted the format of Sample Pretrial Order No. 5 of the Manual for Complex and Multidistrict Litigation for the submission of final pretrial briefs.

0.5.4.2 The pretrial briefs submitted by the parties set forth, in separately numbered declarative sentences, the narration of facts relied upon in support of each claim for relief. Legal contentions and authorities in support of the claims for relief which were the subject of the narrative statement of facts were separately stated in separately numbered paragraphs. Similarly, opposing briefs set forth separate factual statements admitting or denying those of the adverse party, or presenting affirmative matters of a factual nature, and a statement of legal contentions and authorities in defense against the claim for relief to which the response was made.

0.5.4.3 Honeywell found that the separately numbered factual sentence format of the pretrial briefs lent itself to a computerized data storage and retrieval system. In this way, Honeywell's numbered narrative statement, with designated supporting evidence, and SR and ISD's admissions or denials, together with designated opposing evidence or affirmative narrative statement, were available in computer printout form (sometimes referred to by the parties as Honeywell's Computerized Brief or "CB").

0.5.4.4 During the course of the trial, Honeywell's computerized data storage and retrieval enabled the up-dating and annotating of its narrative statement in accordance with the trial evidence. In addition, cumulative lists and indices of exhibits and testimony were also subject to this computerized data storage and retrieval and were made available after the close of the trial.

0.5.4.5 After trial, extensive and comprehensive post-trial briefs of both parties were submitted, following the narrative statement format of the pretrial briefs but further supplemented by so-called "conventional" briefs containing strong advocacy by which counsel have been less than kind to each other. The Court has not lacked for thorough presentation by both parties on all issues in their pretrial and post-trial briefs.

0.5.5 The Court further had the benefit of numerous documentary aids in dealing with the special terminology and content of complex electronic and financial evidence, as well as rules and customs of patent practice, involved in the reconstruction of over three decades of past history underlying the modern day computer industry. For example:

0.5.5.1 Glossary of Principal Terms, Appendix A to Volume I of Plaintiff's Trial Brief.

0.5.5.2 General Information Concerning Patents, Appendix B to Volume I of Plaintiff's Trial Brief.

0.5.5.3 Plaintiff's Exhibit 21755.7, Abstract of the Patent Office History, U.S. Patent Application Serial Number 757.158 [the ENIAC patent application], and defendants' response thereto in their Appendix to Request for Findings.

0.6 On April 9, 1973, the Court advised counsel for the parties of ultimate Findings made upon the evidence of record. The decision reached is a mixed one, and the aid of both parties has been sought through the submission of more detailed Findings on those issues where plaintiff or defendants have prevailed.

0.6.1 The Court's ultimate Findings are grouped under twenty-five numbered topics, substantially in the order treated by counsel in their briefs. The ultimate and detailed supportive Findings are set forth below under these topics by decimal sub-numbering.

0.6.2 The nature and complexity of the issues upon which the facts have been found has resulted in an intermingling, where appropriate, of related conclusions of law under ultimate Finding topics.

0.6.3 The Findings are therefore both an amalgamation of findings of fact and conclusions of law, and an amalgamation of the supportive contributions of each party as to the respective issues upon which they have prevailed in whole or in part.

0.6.4 Findings 1 through 12 below are concerned primarily with the validity and enforceability of defendants' electronic data processing (EDP) or so-called "computer" patent rights against plaintiff. Findings 13 through 23 below deal more particularly with the anti-trust issues arising out of the procurement, licensing and enforcement of those patent rights, and other business conduct of SR in the EDP industry. Findings 24 through 26 pertain to legal matters and relief.

0.6.5 All legal citations which support the Findings and Conclusions herein are located in the Appendix hereto at the corresponding decimalized number.

0.6.6 In reaching these Findings, the Court has weighed the evidence relating to defendant's patent rights and business activities against the background evidence which was presented to show:

0.6.6.1 the history of technical evolution of automatic electronic digital computing from the earliest mechanical aids to the modern day computer;

0.6.6.2 the history of development of her EDP industry, from the early business efforts of SR's predecessors, and of International Business Machine Corporation (IBM) and others, including Honeywell, to the time of this lawsuit;

0.6.6.3 the history of design and construction of the earliest automatic electronic digital computers and, particularly, the so-called "ABC" (Atanasoff-Berry Computer) at Iowa State College, and the "ENIAC" machine (Electronic Numerical Integrator and Computer) of Army Ordnance at the Moore School of the University of Pennsylvania;

0.6.6.4 the work of Dr. John W. Mauchly (Mauchly or sometimes simply M), J. Presper Eckert, Jr., (Eckert or sometimes simply E) and many others in connection with the ENIAC machine, and in connection with their subsequent business activities for Electronic Control Company (ECC) and Eckert-Mauchly Computer Corporation (EMCC) and Remington Rand, Inc. (RR), as predecessors of SR;

0.6.6.5 the procurement of a patent describing and claiming "the invention" embodied in the ENIAC machine (the ENIAC patent), and the history of its lengthy prosecution before the Patent Office, including interference proceedings, controversies with IBM, and litigation with Bell Telephone Laboratories, Inc. (BTL);

0.6.6.6 the history of use of the ENIAC machine, including such important use as: calculations for the Los Alamos Scientific Laboratory of the University of California (Los Alamos Laboratory) and Dr. Edward Teller relating to the hydrogen bomb and calculations by Dr. Douglas R. Hartree relating to supersonic airfoils and projectiles;

0.6.6.7 the history of commercialization and further evolution of the ENIAC and computer machine work, including: the activities of the Moore School in the development of an "EDVAC" (Electronic Discrete Variable Automatic Computer) machine, and the description of a design for such a machine by Dr. John von Neumann; and the activities of Eckert and Mauchly and the ECC and EMCC, RR business enterprise predecessors of SR in the development of EDVAC, BINAC, and UNIVAC machines;

0.6.6.8 the procurement and continuing prosecution of patents and applications (referred to at Paragraph 30A of the Second Amended Complaint) on developments arising out of the commercialization and further business activities of Eckert and Mauchly based on the work on the ENIAC and EDVAC machines;

0.6.6.9 a detailed technological, financial and economic survey of the EDP industry's major or so-called "main frame" manufacturers who are the producers of full EDP systems, including such matters as gross dollar values of EDP sales, rentals and research and development expenditures by SR, IBM, Honeywell, Radio Corporation of Amercia (RCA), National Cash Register Company (NCR), Burroughs Corporation (Burroughs), General Electric Company (GE),

Control Data Corporation (CDC), and Philco-Ford Corporation (Philco-Ford); and

0.6.6.10 the convergence of all of these historical and evolving forces upon the extraordinary automatic electronic digital computer and the EDP industry today: an industry producing EDP systems which perform an almost limitless variety of electronic data processing operations at the seemingly incredible speed of a millionth of a second (microsecond) or even a billionth of a second (nanosecond) and of persisting in the work for hours on end, and thus completing tasks beyond the capacity of human bodies and minds.

0.7 The Findings, as an amalgamation as aforesaid, are nonetheless the result of as careful and detailed attention as could be given to a most fascinating, albeit burdensome lawsuit. Where conflicts existed in the testimony, facts have been found on the basis of close observation of the appearance, conduct and demeanor of the witnesses and to contemporaneous documentation or exhibits, wherever available.

0.8 Hence, the Findings, hereinafter set forth, represent the final culmination of an extraordinary part of history such as this Court has seldom confronted; the Findings are an effort at summation of a truly complex lawsuit in a relatively condensed form.

0.9 The Findings which follow, therefore, constitute the Court's decision in compliance with Rule 52 and all applicable provisions of the Rules of Civil Procedure and of law.

1. Public Use

1.1 The claimed invention disclosed in the ENIAC ('606) patent was in public use prior to the critical date.

1.1.1 The ENIAC patent, No. 3,120,606, discloses and claims the ENIAC machine constructed at the Moore School of Electrical Engineering of the University of Pennsylvania.

1.1.1.1 The ENIAC machine was an electronic computer of monstrous size, built during wartime with government funds by a team of Moore School employees. It employed some 18,000 vacuum tubes, hundreds of switches, thousands of relays, and miles of wiring. Defendants contend that the ENIAC machine is properly regarded as the pioneer electronic computer from which all others evolved.

1.1.1.2 The ENIAC machine is described in a Final Report which was prepared by the Moore School team, transmitted to and accepted by Army Ordnance by about June 6, 1946. There are no significant differences between the ENIAC machine as constructed and placed in operation, and the ENIAC machine as described in the Final Report.

1.1.1.3 The descriptive content of the ENIAC patent disclosure was extracted from and based upon corresponding portions of the Final Report description of the ENIAC machine. There are no significant differences between the subject matter described in the Final Report and the claims of the ENIAC patent.

1.1.1.4 The patentees of the ENIAC patent state therein that the ENIAC machine "embodies our invention" and are bound thereby. Conduct with respect to that ENIAC machine is, therefore, conduct with respect to "the invention."

1.1.1.5 SR and ISD have further characterized the subject matter of the ENIAC patent as "the invention of the Automatic Electronic Digital Computer," and are bound thereby. Conduct with respect to an automatic electronic digital computer is, therefore, conduct with respect to "the invention."

1.1.1.6 Each of the claims of the ENIAC patent reads on the ENIAC machine as it was constructed and placed in operation at the Moore School and described in the Final Reports.

1.1.1.7 The ENIAC machine which was represented by Eckert and Mauchly to be that which "embodies our invention" is identical with the ENIAC invention, however claimed.

1.1.1.8 Counsel for defendants did not object to the Court's statement at trial that there was no dispute about the fact that Eckert and Mauchly claimed to be the two sole joint inventors of the ENIAC, from input all the way through to output.

1.1.1.9 For the foregoing reasons, there is no necessity to make specific reference to the individual claims of the ENIAC patent where conduct barring the valid issuance of a patent is conduct involving either the same ENIAC machine (as will be set forth hereinafter with respect to the bars of public use and on sale), or involving a prior automatic electronic digital computer (as will be set forth

hereinafter with respect to the bars of derivation from Atanasoff and prior publication by von Neumann).

1.1.1.10 Where an additional bar to less than the all-inclusive entirety of "the invention" has also been found herein, specific selected claims of the ENIAC patent have been applied and essentially cumulative further findings particularized by claims are also hereinafter included.

1.1.1.11 The entire subject matter of the ENIAC machine, represented by Eckert and Mauchly to be that which "embodies our invention," is barred from valid patentability since that machine was in public use in this country more than one year prior to the date of the application for patent on June 26, 1947. The one-year-prior or statutory bar date is referred to as the "critical date," and is June 26, 1946.

1.1.2 The ENIAC machine was constructed by mid-November, 1945.

1.1.2.1 The design for the ENIAC machine was frozen prior to the end of 1944 so that the construction of the machine could be completed as rapidly as possible to confirm the usefulness of electronic computation with such large machines.

1.1.2.2 By mid-1945, the construction of the various ENIAC units was complete and testing of the completed units had commenced.

1.1.2.3 The ENIAC was placed in operation as a system in mid-November, 1945.

1.1.2.4 Moore School and Army Ordnance representatives considered that the ENIAC machine was being operated rather than tested after December 1, 1945.

1.1.3 The ENIAC machine which embodied "the invention" claimed by the ENIAC patent was in public and non-experimental use for the following purposes, and at times prior to the critical date:

Los Alamos calculations December, 1945–February, 1946
International publicity
1. Press demonstration use February 1, 1946
2. Newsreel use February 8, 1946
3. Formal dedication use February 15, 1946
4. Open house use February 16, 1946
Hartree calculations April, 1946–July, 1946
Constant practical use December, 1945–June, 1946
Commercial solicitation uses February, 1946–April, 1946

1.1.3.1 The Court finds that PX 4245, a March 19, 1946 letter from Major W. Stephens, Jr., to Mr. A. Borbeck, Artillery Branch, which was never previously called to the attention of either the Patent Office or the late Judge Archie O. Dawson in the case of Sperry Rand Corporation et al. v. Bell Telephone Laboratories, Inc. hereinafter SR v. BTL) before the Southern District of New York, clearly indicates that prior to March, 1946 the ENIAC machine was "completed with the performance of research and experimental work in connection with the development of an Electronic Numerical Integrator and Computer."

1.1.3.2 SR and ISD contend that the correspondence of November, 1946, between the Moore School and the Army Ordnance patent section responsible for preparation of the ENIAC patent application (referred to by the names of the writers as the "Sharpless/Libman letters") has no probative value. Despite an error in the date of the press demonstration as recited in PX 5374, the Sharpless/Libman letters otherwise have great probative value and clearly indicated to Army Ordnance attorney Max L. Libman, who was then preparing the ENIAC patent application, that the completed ENIAC machine was first put to work for practical purposes on December 10, 1946, on a set of partial differential equations for the Manhattan Engineering District (hereinafter "the Los Alamos calculations or problem"). That initial work was not considered experimental since the letter states that "when the first problem was put on the machine it was the first time that the machine as a whole was being used, it was fully expected that the problem would be solved and it was."

1.1.4 The Los Alamos calculations which commenced December 10, 1945, were the first problem placed on the ENIAC machine. When the first problem was put on the machine it was the first time that the machine as a whole was being used. It was fully expected that the problem would be solved. It was.

1.1.4.1 The ENIAC machine, and hence any invention claimed in the ENIAC patent, was reduced to practice no later than the date of commencement of the machine for the Los Alamos calculations, December 10, 1945.

1.1.4.2 The ENIAC project for the development of a high-speed electronic computer was made known to Dr. John von Neumann Army Ordnance scientific consultant) by Dr. Herman H. Goldstine (Army Ordnance liaison officer on the ENIAC project) in the summer of 1944, after the ENIAC design had been frozen.

Von Neumann visited the Moore School in July, 1944, and witnessed two ENIAC accumulator units and a cycling unit wired to function as a small ENIAC machine. By early 1945, von Neumann had begun consideration of how the ENIAC machine could be organized and operated to solve complex problems.

1.1.4.3 By the summer of 1945, Dr. Edward Teller, Dr. Stanislaw Ulam and other scientists of the Los Alamos Laboratory had already recognized the urgent need for large-scale numerical calculations designed to certify the feasibility of a hydrogen bomb design concept having several parameters including various mixtures of deuterium and tritium. Teller discussed his computational needs with von Neumann who indicated his belief that the ENIAC machine would be suitable for performing certain calculations regarding the feasibility of the hydrogen bomb, called the "Super."

1.1.4.4 The calculations to be performed were complex and required a large number of arithmetical computations. They were not intended to provide a particular numerical answer or series of answers, but rather were contemplated to provide, and did provide, the basis for a yes or no answer on the utility of continued scientific exploration of the "Super."

1.1.4.5 Useful results could be and were obtained from such calculations on the ENIAC machine even though calculational errors may have occurred in some of the primary and intermediate calculations.

1.1.4.6 Army Ordnance agreed, in 1945, to allow the use of the ENIAC by Los Alamos Laboratory personnel at the Moore School for the Los Alamos calculations.

1.1.4.7 At or about the time in December, 1945, when the Los Alamos calculations were placed on the ENIAC machine at the Moore School in Philadelphia, the machine had passed all component and system tests and was operating quite satisfactorily. The Los Alamos calculations employed 99 percent of the capacity of the ENIAC machine.

1.1.4.8 The satisfactory operation of the ENIAC machine was verified during the Los Alamos calculations by:

.1 repeating a particular production run twice and then verifying that the results obtained for each repetition were identical;

.2 stepping the ENIAC through a calculation and checking all answers after each add time;

.3 running a test problem between successive runs and checking the answer obtained to determine that it corresponded to the known answer of the test problem.

1.1.4.9 After satisfactory operation of the ENIAC machine was verified by comparing a hand calculated answer to the ENIAC machine answer for selected calculations, various conditions of the Los Alamos problem were changed to obtain production runs for which the answer had not been previously hand calculated.

1.1.4.10 By January, 1946, many production runs for the Los Alamos calculations were completed. The calculations continued in progress for considerably over one month.

1.1.4.11 Any difficulties encountered were not with the machine but with the mathematical nature of the problem and mistakes of the mathematicians who had designed the problem for the machine.

1.1.4.12 The use of the ENIAC machine by the Los Alamos Laboratory personnel was not under the control of Eckert and Mauchly, nor under any condition of secrecy for their private benefit. The Moore School also had no control over the use of Army Ordnance's ENIAC machine by the Los Alamos personnel.

1.1.4.13 The ENIAC machine was used to perform numerous production runs for the Los Alamos calculations beginning in December, 1945, and continuing in January-February, 1946, and the consequences of these calculations were far-reaching and thoroughly practical.

1.1.4.14 The results of the Los Alamos calculations using the ENIAC machine were included in three Los Alamos reports which show or state in substance that without the ENIAC machine, important work on nuclear energy release problems could not have been done at the time. The Court concurs with Dr. Teller that one of the reports, in April, 1946, delivered a verdict on the feasibility of a thermonuclear bomb: difficult, but with hard work and concentrated effort, hopeful.

1.1.4.15 The contribution of the ENIAC machine in performing the Los Alamos calculations was acknowledged on March 18, 1946, by Dr. Norris Bradbury, Director of the Los Alamos Laboratory, as being of very great value in the work on the project. The Los Alamos calculations using the ENIAC machine were a

substantial effort which successfully and satisfactorily solved specified problems, and the results were useful and did not lie dormant.

1.1.4.16 The use of the ENIAC machine for the Los Alamos calculations was a non-experimental public use in this country prior to the critical date of the claimed invention disclosed in the ENIAC patent, and an absolute statutory bar to the valid issuance of the ENIAC patent.

1.1.4.17 The Court credits the live testimony of distinguished scientists who were contemporaneous participants in these events including Drs. Teller, Ulam, Mark, Metropolis and Frankel of the Los Alamos Laboratory and Dr. Goldstine of Army Ordnance. The testimony of Eckert and Mauchly did not contradict such testimony or the contemporaneous circumstances.

1.1.5 Upon completion of the construction of the ENIAC machine by mid-November, 1945, and commencement of its full-scale operating use by December, 1945, Army Ordnance generated international publicity to show to all the world the developments in computing which had been proved operational.

1.1.5.1 The general principles of the ENIAC design and the machine's operational and functional characteristics were unclassified after December 17, 1945.

1.1.5.2 Only certain design details and circuits of the ENIAC remained classified Confidential after December 17, 1945, and this designation:

.1 was not made for the benefit or protection of Eckert and Mauchly;

.2 was not made at the request of Eckert and Mauchly;

.3 but was made by Army Ordnance to protect circuits of the machine being used by other military departments, including the Army Signal Corps.

1.1.5.3 The security classification of the ENIAC circuits and design details was not a matter under the control of Eckert and/or Mauchly. After the declassification in 1945, the design details and circuits of the ENIAC were left confidential until February, 1947, solely at the discretion of and for the benefit of the Government, and not for the commercial business interest and private benefit of Eckert and Mauchly.

1.1.5.4 The Army Ordnance international publicity program for the ENIAC machine was extensive and well planned, and Eckert and Mauchly as participants therein had been warned that the display of the machine would foreclose any of their private patent rights if not promptly pursued.

1.1.5.5 In January, 1946, formal press releases were prepared by Army Ordnance for release immediately following the dedication ceremony which was scheduled to be held on February 15, 1946. Mauchly's diary entries attest to his role in personally editing the Army Ordnance press releases to insure specific recognition of Eckert and him.

1.1.5.6 Eckert and Mauchly cooperated in the preparation and planning of the efforts of Army Ordnance and the Moore School to achieve saturation publicity for the completion of the ENIAC, including press releases, interviews, speeches, newsreels, press demonstrations, formal dedication and the Moore School open house, such as:

.1 Eckert and Mauchly delivered prepared remarks on the utility and speed of the ENIAC machine to reporters who attended the press demonstration;

.2 Mauchly prepared and delivered a speech to the reporters at the press demonstration explaining that the ENIAC machine demonstrated that it was possible to utilize electronic computers to solve many problems never previously solved; and

.3 Eckert delivered a speech at the press demonstration and informed reporters that the ENIAC machine had sounded the death knell to the era of electro-mechanical computing devices, and that the advent of the ENIAC machine had made electronic computers a part of the concrete present rather than a vague promise of the future.

1.1.5.7 The ENIAC machine was operated at the press demonstration on February 1, 1946, for publicity purposes, and in manner calculated to be impressive through the press to the general public.

1.1.5.8 One of the calculations illustratively demonstrated was the use of the ENIAC machine to add the number 97,367 to itself 5,000 times, as was visible on the face of the accumulators. After the 5,000 additions were completed, the result was checked and it was determined that the ENIAC machine had properly performed the calculation.

1.1.5.9 As another demonstration calculation, the ENIAC machine multiplier was used to multiply 13,975 times 13,975 500 times, and the product was checked and found to have been properly calculated.

1.1.5.10 As another demonstration calculation, the ENIAC machine was used to produce a table of squares and cubes of the numbers from 1 to 100. The ENIAC machine functioned properly during the preparation of the table, and the results were error free.

1.1.5.11 As another demonstration calculation, the ENIAC machine was used to compute the sines and cosines for 100 different angles, and the table prepared was punched on so-called tab cards, printed on paper, and distributed to members of the press. The ENIAC machine functioned properly during the preparation of the table of sines and cosines, and correct results were obtained for each computation.

1.1.5.12 As another demonstration calculation, the ENIAC machine performed representative calculations arising out of the Los Alamos Laboratory work. A printed copy of the results or so-called printout of a number of Los Alamos-type calculations was prepared and distributed to the attendees at the press demonstration. These calculations utilized substantially the full capacity of the ENIAC machine, and contained no errors attributable to malfunction of the ENIAC machine.

1.1.5.13 Although the demonstration calculations performed on the ENIAC machine for the press were not intended by Army Ordnance or the Moore School to be for the private benefit or on behalf of Eckert and Mauchly, they were in fact later relied upon by them for that financial purpose. In no event were the calculations performed in order to enable Eckert and Mauchly to complete or perfect the making of "the invention" embodied in the ENIAC machine.

1.1.5.14 The use of the ENIAC machine in public during the press demonstration was not an experimental use, but was a publicity exercise in joint behalf of the Moore School and Army Ordnance, and was intended to impress the scientific community and the general public with the capabilities of the machine and the fact of its completion.

1.1.5.15 The use of the ENIAC machine to perform calculations during the February 1, 1946, press demonstration was a non-experimental public use of the claimed invention disclosed in the ENIAC patent, prior to the critical date and an absolute statutory bar to the valid issuance of the ENIAC patent.

1.1.5.16 The ENIAC machine was filmed in staged operation in February, 1946, for the benefit of newsreel photographers, for publicity purposes, and in a manner calculated to provide a motion picture demonstration to be shown nationally to the general public.

1.1.5.17 The use of the ENIAC machine for the newsreel photographers was not an experimental use, but was part of the large-scale international publicity program calculated to impress the public with the capabilities of the machine and the fact of its completion.

1.1.5.18 The ENIAC machine was formally dedicated on February 15, 1946, for publicity purposes, at a ceremony involving preeminent representatives of government, military, university, industrial and scientific establishments, and in a manner calculated to achieve maximum recognition of and to stimulate interest in the completed and operating ENIAC machine.

1.1.5.19 As of the date of the dedication and demonstration of the ENIAC machine at the Moore School on February 15, 1946, the ENIAC machine was represented to be, and was in fact, completed and successful.

1.1.5.20 During the dedication demonstration of the ENIAC machine, a ballistic trajectory problem was run as a simple means for impressing observers with what the machine could do. Although the trajectory data was simplified for the demonstration, the basic arithmetical operations of adding, subtracting, multiplying and dividing which would be done in a complete trajectory problem were performed. Any variance between the trajectory calculations performed during the dedication and an actual trajectory occurred as a result of programming simplifications rather than as a result of any operating defects in the ENIAC machine.

1.1.5.21 Although complete ballistic firing tables were not prepared during the dedication, the demonstration was intended to and did show that such tables could be prepared by repeating the trajectory calculations as performed with different input conditions. The data used was real and had been verified beforehand. The ENIAC machine did not err.

1.1.5.22 None of the calculations performed on the ENIAC machine at the dedication were performed for the private benefit or on behalf or under the control of Eckert and Mauchly to enable them to complete or perfect the making of "the invention" embodied in the ENIAC machine. Instead, their private interest was one of commercial exploitation (see 1.1.5.6 and .13 above).

1.1.5.23 The use of the ENIAC machine in public at the formal dedication was not an experimental use, but was part of the large-scale publicity program calculated to impress the public with the capabilities of the machine and the fact of its completion.

1.1.5.24 The use of the ENIAC machine to perform calculations during the dedication was a non-experimental public use of the claimed invention disclosed in the ENIAC patent, prior to the critical date, and an absolute statutory bar to the valid issuance of the ENIAC patent.

1.1.5.25 The ENIAC machine was publicly exhibited and demonstrated in operation on February 16, 1946, at an "open house" for the invited entirety of the Moore School staff and student body. At the open house, the same ballistic trajectory calculations that were performed at the dedication were again performed. The ENIAC machine operated satisfactorily at the open house.

1.1.5.26 The use of the ENIAC machine in public at the open house was a non-experimental public use of the claimed invention of the ENIAC patent, prior to the critical date, and an absolute statutory bar to the valid issuance of the ENIAC patent.

1.1.5.27 The Court has heard from numerous live witnesses regarding the international publicity regarding the completion and successful operation of the ENIAC machine and saw the ENIAC newsreel exhibited during the testimony of Dr. Goldstein. The Court credits this testimony.

1.1.6 Dr. Douglas R. Hartree, a highly regarded British scientist, used the completed ENIAC machine in 1946 prior to the critical date to perform complex and fundamental calculations relating to the performance of airfoils at supersonic speeds in air.

1.1.6.1 As early as 1939 Hartree had begun his study of methods for the solution of equations involved in laminar boundary layers in compressible flow. The equations are applicable to the field of supersonic aircraft design, as well as to the design of various projectiles.

1.1.6.2 Hartree's study of the laminar boundary layer in compressible flow was not a single problem for which a single answer was to be calculated, but was instead a broad investigation involving numerous computations using the ENIAC machine, each of which resulted in large groups or families of calculations or solutions which were to be compiled in the form of tables. The ENIAC patent states that the primary intended use of the ENIAC machine is to compute such large families of solutions.

1.1.6.3 Hartree visited the United States in 1945, saw the nearly completed ENIAC machine, and was furnished copies of the ENIAC progress reports. He commented on the ENIAC machine in an article published in Nature magazine in England on April 20, 1946.

1.1.6.4. Because of his knowledge of the ENIAC project gained from viewing the ENIAC machine in 1945 and the material in the progress reports, Hartree, when he arrived in the United States in April, 1946, had already reduced laminar boundary layer equations to a form suitable for solution by using the ENIAC machine. Hartree also brought working charts to the United States which described how the ENIAC machine was to be programmed by plug wiring and set up to perform the calculations required.

1.1.6.5 Prior to his visit to the United States in the spring of 1946, Hartree had already studied some special cases of the boundary layer equations which are described as null (or zero) order functions and had hand-calculated five-figure solutions to some of the families of calculations. The other cases of the study of the laminar boundary layer in compressible flow are described as the higher order functions. At the time that Hartree arrived in the United States, he brought with him the hand calculations of the null-order functions of the boundary layer equations.

1.1.6.6 Mauchly's present wife, then Kathleen McNulty, was assigned by Army Ordnance to plug in wire on the ENIAC machine according to the programming charts which Hartree had brought with him to the United States.

1.1.6.7 Hartree began his work on the ENIAC machine by evaluating the null-order equations. Calculation of the null-order equations using the ENIAC involved the basic operations of adding, multiplying and dividing. The calculation of the null-order functions on the ENIAC machine required a number of production runs, each of which produced results in the form of a stack of punched cards.

1.1.6.8 Hartree's calculations using the ENIAC machine were complex and carefully planned, and required the operating capacity of the entire machine.

1.1.6.9 Hartree's use of the ENIAC machine began in April, 1946, and he successfully used the machine to perform useful calculations and produce large families of solutions of the null-order functions. Hartree checked the results by comparing solutions obtained from the ENIAC machine with corresponding five-figure solutions which had been hand-calculated by him prior to his arrival in the United States. Hartree completed his evaluation of the null-order functions prior to the critical date for the ENIAC patent application. Completion of these null-order functions was a substantial independent portion of Hartree's intended complete study of the laminar boundary layer in compressible flow. Also prior to the critical date for the ENIAC patent application, Hartree had successfully used the ENIAC machine to provide useful answers to practical study of the laminar boundary layer in compressible flow.

1.1.6.10 Hartree's use of the ENIAC machine in 1946 on his own boundary layer problem was as a consultant employed and paid by Army Ordnance. Hartree was neither an agent nor employee of either Eckert, Mauchly or the Moore School, nor under any obligation of secrecy or otherwise to any thereof.

1.1.6.11 Prior to the critical date, Hartree described to Mauchly in detail the nature of the calculations that he had performed using the ENIAC machine, and Mauchly made notes of the discussion. Mauchly testified that he knew at the time of Hartree's visit that Hartree was working at the time on a problem in fluid dynamics which had to do with boundary layers and that this made sense because Mauchly had dealt with similar problems in the wind tunnel at the Bureau of Standards in the 1930's. Mauchly testified that he attended a lecture at the Moore School given by Hartree in which the boundary layer calculations were described.

1.1.6.12 Mauchly and Eckert, who had by then resigned from the Moore School, did not evaluate the results of the calculations run by Hartree to learn or to decide if any design changes to the ENIAC machine were necessary. They were not authorized to make any changes and did not make any. Although Eckert and Mauchly were aware of the fact of Hartree's use of the ENIAC machine, they neither allowed, participated in nor exercised any control over that use or over any of its consequences.

1.1.6.13 Hartree's calculations were of scientific importance and the subject of significant published papers, upon which Eckert and Mauchly later relied for their private business advantage. Hartree left the United States to return to England on July 20, 1946. In October, 1946, Nature magazine published a further article by Hartree on the ENIAC machine and his calculations on the laminar boundary layer problem. The Hartree October Nature article briefly described the method used for solving the three simultaneous, linear, ordinary, differential equations which were said by Hartree to arise from the theory of the laminar boundary layer in a compressible fluid. Eckert and Mauchly's partnership, Electronic Control Company, later reprinted the article in an advertising brochure in which it was stated that "the article represented here is based on his [Hartree's] first hand experience in using the ENIAC."

1.1.6.14 The use of the ENIAC machine by Hartree was a non-experimental public use in this country of the claimed invention disclosed in the ENIAC patent, prior to the critical date, and an absolute statutory bar to the valid issuance of the ENIAC patent.

1.1.6.15 This Court has considered Hartree's article in the 1948 Philosophical Transactions of the Royal Society and the testimony of Dr. Goldstine and Dr. Clippinger (a former Army Ordnance employee with contemporaneous knowledge of the ENIAC machine, and a present Honeywell employee), as against the conflicting testimony by defendants' counsel Hall, and holds that the Hartree article is a description of the pre-critical-date work and includes a tabulation of some of the families of solutions which he obtained prior to the critical date. Clippinger also testified that a recheck of the results on a high speed modern computer had demonstrated the correctness of Hartree's result. The Court has considered and credits the testimony of Dr. Clippinger to the effect that the Hartree article indicates that the ENIAC machine gave Hartree correct results.

1.1.7 The use of the ENIAC machine by Army Ordnance after December 1, 1945 and prior to the critical date, involved no question of whether the machine worked or how it could be improved by Eckert and Mauchly as claimant inventors for their own private advantage, but was instead a program of production operation under the sole control of Army Ordnance entirely for governmental uses, purposes and benefits.

1.1.7.1 Beginning with the Los Alamos calculations in December, 1945, and extending to the ENIAC patent critical date, the ENIAC machine entered a period of constant practical use under the control of Army Ordnance.

1.1.7.2 In addition to the public use of the ENIAC machine for the Los Alamos calculations and the Hartree problem, there are other uses which cumulatively confirm the public use of the ENIAC machine, prior to the critical date.

1.1.7.3 None of the specific instances of ENIAC machine operation between December 10, 1945, and the critical date, comprising, in sum, a history of constant practical use of the ENIAC machine by Army Ordnance, were carried out under the control of, or in any way for the private benefit of, Eckert and Mauchly, or under any obligation of secrecy to Eckert and Mauchly.

1.1.7.4 None of these other examples of the use of the ENIAC machine were carried out for the purpose of completing or perfecting the making of "the invention" of Eckert and Mauchly embodied in the ENIAC machine.

1.1.7.5 After the Los Alamos calculations, the ENIAC was in more or less continuous use being set up for or in actual work in solving problems. All so-called testing, de-bugging and troubleshooting was normal operation and continued throughout the useful life of the ENIAC machine.

1.1.7.6 When Eckert's connection with the ENIAC project was terminated in March of 1946, the machine had been completed and running for some time and was in use by Army Ordnance, and Eckert so testified in 1954. At least by January, 1946, the ENIAC machine was a complete and operable calculating instrument, and Mauchly so testified in 1954. Neither Eckert nor Mauchly testified to the contrary before this Court.

1.1.7.7 There were no long periods of maintenance or repair shutdown, and the general practice was to operate in a continuous schedule and shut down only when a fault became apparent. The percentage of hours used for computing time was quite high, and Eckert and Mauchly so testified, so that Sperry Rand's attorney Wobensmith summarized Mauchly's testimony to that effect in 1954.

1.1.7.8 Harry Huskey, of the Moore School staff, operated the ENIAC machine, from April 15 to April 19, 1946, to generate a table of sines and cosins and this use was called to the attention of Libman, the Army Ordnance attorney who prepared and filed the ENIAC patent application for Eckert and Mauchly, prior to that filing. Eckert and Mauchly did not evaluate the results of Huskey's calculations to determine whether or not any changes in the ENIAC design were necessary in the light of the results obtained, nor were any changes ever recommended or made by them or for them.

1.1.7.9 The constant practical use of the ENIAC machine after December 1, 1945, was a non-experimental public use of the claimed invention disclosed on the ENIAC patent prior to the critical date, and an absolute statutory bar to the valid issuance of the ENIAC patent.

1.1.8 Eckert and Mauchly took commercial advantage of Army Ordnance's public uses of the ENIAC machine and also placed the ENIAC machine in public use themselves by demonstrating it to potential customers as a part of their attempts to commercialize the ENIAC machine subject matter prior to the critical date.

1.1.8.1 Eckert and Mauchly intended that the widespread publicity to be gained for them personally from the ENIAC press demonstration, dedication and open house in February, 1946, would advance their private commercial business interests.

1.1.8.2 More than one year prior to the June 26, 1947 filing date of the ENIAC patent, beginning at least as early as the fall of 1944, Eckert and Mauchly placed the claimed invention disclosed in the ENIAC patent in public use and on sale by describing and demonstrating the ENIAC machine to their intended customers for their own commercial gain.

1.1.8.3 Eckert and Mauchly took full private business advantage of the publicity and dedication activities as a convenient forum for their solicitation of future computing machine contracts from government agencies.

1.1.8.4 During the fall of 1944, Mauchly called on various potential customers to determine the business prospects for selling high-speed computing or data processing machines. Prior to October, 1944, the ENIAC two-accumulator system had been successfully built and operated. The completion of the ENIAC two-accumulator system gave Eckert and Mauchly a tool by which they could convince potential customers that a high-speed computing or data processing machine could in fact be successfully built.

1.1.8.5 Army Ordnance's contract (W-670-ORD-4926) for the ENIAC project work required the University of Pennsylvania to grant the U. S. Government a royalty-free license under all patents arising from the work done under the contract. However, since the employment agreements of the engineers working on the ENIAC project did not clearly require any assignment of their invention rights to the University of Pennsylvania, the University was not in a position to grant the Government such a license.

1.1.8.6 Prior to March, 1945, Eckert and Mauchly sought advice from George A. Smith, a patent attorney, on methods of securing for themselves the commercial invention rights arising from the work under the Army Ordnance contract. Pursuant to his advice, Eckert and Mauchly asked the University of Pennsylvania for the right to have their own patent attorney file patent applications in their names on ideas arising out of the work on the project. During March, 1945, Eckert and Mauchly pressed for recognition of their commercial interests by the University of Pennsylvania in return for assurances that they would help the University fulfill its obligations under the contract. Facing the fact that it would require the cooperation of Eckert and Mauchly to fulfill its contractual obligations to the U. S. Government, the University yielded the commercial rights to any patents they might obtain based on the work on the contract.

1.1.8.7 Mauchly was in personal contact with personnel of the U.S. Weather Bureau as early as April, 1945, to learn their computing needs and to discuss the ENIAC and future work with them. Eckert and Mauchly also followed up their interest in business prospects at the U. S. Census Bureau throughout the summer of 1945.

1.1.8.8 On other ocacsions during 1945, Eckert and Mauchly called on about a dozen Census Bureau officials including Everett Kimball, Jr., Dr. Madow, Morris H. Hansen, and James L. McPherson, in order to interest them in high-speed computing or data processing machines. Hansen assigned McPherson the task of evaluating Eckert and Mauchly's proposals regarding such a high-speed computing or data processing machine. As a result of this assignment, McPherson held meetings from time to time with Eckert and Mauchly at the Census Bureau. During the meetings with McPherson and other census officials, Eckert and Mauchly described the ENIAC and sought a contract to develop a similar but more advanced machine for the Census Bureau.

1.1.8.9 In order to interest potential financial backers Earnest Cuneo and Lazar Teper in the financial backing of an Eckert-Mauchly computer company, Eckert and Mauchly displayed the ENIAC machine to them in January, 1946.

1.1.8.10 Eckert and Mauchly early sought private business advantage from the fact of the ENIAC machine's completion by the Moore School in 1945 and its constant practical use thereafter by Army Ordnance. For example, on February 15, 1946, Commander Reichelderfer of tne U. S. Weather Bureau attended the ENIAC dedication and dinner on behalf of the U. S. Weather Bureau, being seated at Mauchly's table at Mauchly's request. Mauchly's purpose in having Reichelderfer present was one of private self-interest to advance his business enterprise plans, held jointly with Eckert, by using the occasion of the ENIAC dedication as a business promotion effort. During the dedication, Reichelderfer and the other guests witnessed a demonstration of the ENIAC machine. Thereafter, on February 21, 1946, Eckert and Mauchly again demonstrated the ENIAC machine for Reichelderfer's associates Dr. Harry Wexler and Jerome Namias of the U. S. Weather Bureau, and discussed with them the possible construction of a similar computer for weather purposes. The contacts with and demonstrations for Reichelderfer, Namias and Wexler were attempts to commercialize the invention embodied in the ENIAC machine prior to the critical date, and resulted in non-experimental public uses of the claimed invention disclosed in the ENIAC patent prior to the critical date, constituting an absolute bar to the valid issuance of the ENIAC patent.

1.1.8.11 By mid-March, 1946, Eckert and Mauchly had put out a number of commercial feelers, and were actively pursuing them. For example, on March 20, 1946, in order to promote their sale of a high-speed computing or data processing machine, Eckert and Mauchly made a presentation to the Committee on Tabulation Methods and Mechanical Equipment of the U. S. Census Bureau.

1.1.8.12 On March 22, 1946, Dean Pender of the University of Pennsylvania demanded that Eckert and Mauchly either subjugate their personal commercial interests to the interests of the University or have their employment by the University terminated. On or about March 22, 1946, Eckert and Mauchly sub-

mitted their resignations from the University of Pennsylvania to take effect March 31, 1946.

1.1.8.13 On April 2, 1946, two days after their resignations from the University of Pennsylvania became effective, Eckert and Mauchly met with representatives of the Weather Bureau, Census Bureau, and Bureau of Standards. During that meeting, Eckert again described the ENIAC machine.

1.1.8.14 In order to promote their proposed sale of a computing machine, Eckert and Mauchly invited representatives of the Census Bureau and National Bureau of Standards to witness a demonstration of the ENIAC machine. The demonstration, held April 11, 1946, was attended by Eckert and Mauchly, Dr. John H. Curtiss representing the National Bureau of Standards, and Messrs. A. A. Berlinsky, J. F. Bosen, Morris H. Hansen, and James L. McPherson, representing the Census Bureau. During the April 11, 1946, demonstration, the ENIAC machine was set up and running while its operation was explained. The April 11, 1946, ENIAC demonstration was an essential part of Eckert and Mauchly's implementation of the plan to exploit electronic computing or data processing machines commercially.

1.1.8.15 Following the April 11, 1946, ENIAC machine demonstration, Eckert and Mauchly agreed to submit to the Census Bureau a set of specifications which could be included in any contract which the Bureau would award to them. The April 11, 1946, ENIAC demonstration and Eckert and Mauchly's descriptions of the ENIAC machine were Curtiss' principal sources of information about electronic computing and Eckert and Mauchly's principal credentials for competence and credibility. On or about April 30, 1946, Eckert and Mauchly submitted some tentative specifications of a proposed computing machine the April 11 demonstration.

1.1.8.16 Based on Curtiss' recommendation, Eckert and Mauchly were awarded contract CST–7964 in the fall of 1946 to conduct a design study, including the construction of components, and prepare a report based thereon proposing a computer to be built for the Census Bureau. Contract CST–7964 directly followed from the ENIAC machine demonstration and the sequence of visits and evaluations of the technical competence of Eckert and Mauchly by the Bureau of Standards.

1.1.8.17 Eckert and Mauchly's demonstration of the ENIAC machine on April 11, 1946, was a commercialization by Eckert and Mauchly of the claimed invention disclosed in the ENIAC patent and embodied in the ENIAC machine prior to the critical date, and resulted in a non-experimental public use of "the invention" of the ENIAC patent prior to the critical date, consulting an absolute bar to the valid issuance of the ENIAC patent.

1.1.18 Eckert and Mauchly, in attempting to gain commercial and private business advantage from the pre-critical date early practical operation of the ENIAC machine, and the massive publicity thereof, advertised in their Eckert-Mauchly Computer Corporation literature in 1940 that the ENIAC machine had been put into operation in January, 1946.

1.1.8.19 With regard to the issue of Eckert and Mauchly's commercialization of the ENIAC machine subject matter prior to the critical date, the Court has considered the conflict between, on the one hand, the disinterested testimony of Mr. James L. McPherson and related contemporaneous documentary evidence, and, on the other hand, the testimony of Eckert and Mauchly. The Court credits the testimony of McPherson and corroborating documentary evidence, and holds that Eckert and Mauchly knowingly sought to and did commercialize the ENIAC machine and any invention embodied therein prior to the critical date.

[1] 1.2 The usual standard in civil cases of proof by a fair preponderance of the evidence is easily and clearly satisfied.

1.3 I do not believe that the standard to be applied is that of clear and satisfactory proof or clear and convincing proof or proof beyond a reasonable doubt.

1.4 If necessary for decision, I find that the more stringent standards have been satisfied.

1.4.1 The Court has heard 22 live witnesses over many weeks of the trial relating to the history and facts surrounding the use of the ENIAC machine prior to the critical date. The Court has seen the newsreel film made in February, 1946, showing the ENIAC machine actually being used for its intended purpose in a clearly publicly intended setting.

1.4.2 Thousands of the documents received by the Court bearing on the public use issue originated contemporaneously with the relavant events and were obtained from independent and disinterested sources.

1.4.3 The Court credits this heavy weight of evidence, fully revealed for the first time upon this record, as compelling a finding that the plaintiff has shown by clear and satisfactory proof, or clear and convincing proof, or proof beyond a reasonable doubt, that the claimed invention disclosed in the ENIAC patent was in public use in this country prior to the critical date.

1.5 The use of ENIAC after December 1, 1945, was clearly not experimental in nature.

1.5.1 Defendants contend that all uses of the ENIAC machine prior to the critical date are exempted from their otherwise clear barring effect because they constitute experimental uses under Eckert and Mauchly's control, or for their benefit and were necessary and essential to the completion or perfecting of the making of "the invention" claimed by them. The facts are clearly to the contrary.

1.5.1.1 By December, 1945, Army Ordnance was using its ENIAC machine under an operating contract W–18–001–ORD–1706 (separate from contract 4926 under which the ENIAC machine was built) which provided for the Moore School to furnish sevices for the initial operation of the ENIAC machine at the Moore School pending completion of the building at the Aberdeen Proving Ground where the machine was to be later housed.

1.5.1.2 After the ENIAC machine was put into constant practical use by Army Ordnance in December, 1945, the ENIAC group or team, including Eckert and Mauchly, turned their attention to the commencement of work on the next generation of computer design, the EDVAC.

1.5.1.3 Eckert and Mauchly resigned from the Moore School in March, 1946, and had no further official contact with any of the work with the ENIAC machine after April 1, 1946.

[2] 1.5.2 The pre-critical date uses of the ENIAC machine were not made under the surveillance of Eckert and Mauchly, and for the purpose of enabling them to test the machine and ascertain whether it would answer the purpose intended and to make such altreations and improvements as experience demonstrates to be necessary, and therefore are not excused as experimental uses within the meaning of Elizabeth v. Pavement Co., 97 U.S. 126 (1877). The ENIAC machine demonstrated that it would answer its intended purpose in December 1945 when it was used for production runs on the Los Alamos calculations.

1.5.3 By December 1, 1945, the ENIAC machine was under the custody, dominion and control of the customer, Army Ordnance, and the relationship to the machine of Eckert, Mauchly and the other engineers at the Moore School involved in the ENIAC team effort was ot one of continuing inventorship and experimentation.

1.5.4 The uses of the ENIAC machine from December, 1945, to the critical date were for its intended purpose of performing automatic electronic digital computation, and were not for the experimental purpose of the completion or perfection of the making of "the invention."

1.5.4.1 The uses of the ENIAC machine between December 1, 1945, and the critical date were not in the nature of testing, checking, or exeprimentation, but rather were uses of the ENIAC machine for its intended practical purpose.

1.5.4.2 The Court has considered the ENIAC Service Log and the testimony concerning the various entries which were made in it. The evidence is clear and convincing that the Service Log is a record showing routine maintenance on the ENIAC machine. The fact that such maintenance was performed does not in any way detract from the non-experimental nature of the various ENIAC public uses. The Court has considered the assertion of defendants that the ENIAC Service Log shows that changes to the machine were made. The evidence is clear and convincing that, without exception, the changes recorded in the Service Log were not design changes of any significance to "the invention," but were instead minor and routine refinements or adjustments of a non-inventive nature. This work on the ENIAC machine was done by Homer Spence, the maintenance engineer for ENIAC, after December 1, 1945, and was routine maintenance unrelated to the completion or perfection of "the invention."

[3] 1.5.4.3 The burden of proof of any exemption from the public use bar, such as by reason of experimentation essential to the completion of the making or perfecting of "the invention" by or for Eckert and Mauchly, rests with SR & ISD, and has not been carried. Instead, Honeywell has proven such use to be non-experimental and clearly practical.

2. On Sale

2.1 The claimed invention disclosed in the ENIAC was on sale prior to the critical date.

2.1.1 The entire subject matter of the ENIAC machine, represented by Eckert and Mauchly to be that which "embodies our invention," is barred from valid patentability because that machine was on sale in this country prior to the critical date.

2.1.2 The subject matter of the ENIAC patent, the invention of the automatic electronic digital computer, is barred from valid patentability because that subject matter was on sale in this country prior to the critical date.

2.1.3 All of the development activities at the Moore School, which resulted in the construction and placing in public use of the ENIAC machine, were financed by the United States Government.

2.1.3.1 In 1943, officials of Army Ordnance ordered their Philadelphia office to enter into a fixed price contract (W–670–ORD–4926, hereinafter referred to as the 4926 contract) with the Moore School for research and experimental work in connection with the development of an electronic numerical integrator and computer, generally referred to thereafter by the acronym "ENIAC." On June 21, 1943, the Moore School executed the 4926 contract which was dated June 5, 1943, as a fixed price contract. The 4926 contract provided that any completed part or unit was to be delivered to the Government F.O.B., floor of contractor's plant, as soon as possible after December 31, 1943. It was not until Supplement 5 of the 4926 contract was executed in mid-January 1945 that there was a requirement to complete and deliver any hardware.

2.1.3.2 Supplement 1 of the 4926 contract, dated December 31, 1943, extended the work on ENIAC development from January 1, 1944, until June 30, 1944. In January, 1944, Supplement 2 was added to the 4926 contract to replace the original anti-discrimination clause which was deleted from Supplement 1.

2.1.3.3 The second six months' work done under the 4926 contract, from January 1, 1944, through June 30, 1944, resulted in the freezing of an ENIAC machine design and the completion of a two-accumulator ENIAC system was operating by about June 30, 1944, and was used to solve second order differential equations for a sine wave at the same pulse rate later used on the completed ENIAC machine.

2.1.3.4 Supplement 3 to the 4926 contract extended the time period for the work a third six months until December 31, 1944. Supplement 4 to the 4926 contract provided for research and experimental work on an EDVAC from January 1 to September 30, 1945. The work done under the 4926 contract from July, 1944, to December 31, 1944, was primarily directed toward production and manufacture of the ENIAC machine and little work on EDVAC was done.

2.1.3.5 Supplement 5 to the 4926 contract, agreed to after the expiration of the previous supplement providing for work on ENIAC, retroactively provided funds for ENIAC work for a fourth six-month period from January 1 to June 30, 1945, and added, for the first time, a requirement for the delivery of an ENIAC "pilot model" machine. Supplements 1 to 3 of the 4926 contract had not required the delivery of a pilot model of the ENIAC machine, but rather had provided for the delivery to the Government at the contractor's plant of any equipment completed. Neither the 4926 contract nor any of its supplements included performance requirements for the ENIAC pilot model or a requirement that any hardware be tested before being accepted by the Government.

2.1.3.6 Supplement 6 of the 4926 contract extended the delivery date of the ENIAC pilot model to September 30, 1945. Although Supplement 6 of the 4926 contract required for the first time that the ENIAC pilot model be delivered and accepted before the final contract payment, the contract contained no requirement that the machine do anything, meet any specifications or pass any tests.

2.1.3.7 Supplement 7 to the 4926 contract, dated November 28, 1945, provided for the extension of the work relating to ENIAC until December 31, 1945, and the work relating to EDVAC until January 31, 1946. Supplement 7 did not add any performance requirements to be met prior to acceptance of ENIAC.

2.1.3.8 Supplements 8 and 9 to the 4926 contract affected only the EDVAC work and did not provide for any further work relating to ENIAC.

2.1.3.9 No subsequent supplement to the 4926 contract either extended the completion date for the ENIAC work beyond December 31, 1945 or added performance requirements for the ENIAC machine.

2.1.3.10 The ENIAC machine was in fact under the exclusive custody, dominion and control of Army Ordnance from December 31, 1945, onward.

2.1.3.11 Supplement or change order 10 to the 4926 contract did not provide for any change in delivery date for the ENIAC pilot model or any further ENIAC work but merely corrected the contract term pertaining to place of delivery. Supplements 11 and 12 to the 4926 contract did not in any way affect the delivery

schedule or requirements for the ENIAC machine or provide for any further ENIAC work.

2.1.3.12 Contract W–18–001–ORD–1706 (hereinafter referred to as the 1706 contract), dated November 1, 1945, provided for services of the University of Pennsylvania in connection with the initial operation of the ENIAC machine pending completion of the Ballistic Research Laboratory Computing Annex Building.

2.1.3.13 Army Ordnance operation of the ENIAC machine at the Moore School was provided for by the 1706 contract, under which the University of Pennsylvania supplied electrical power, space to house the ENIAC machine and a Government computing group, and provided the services of two wiremen to maintain the ENIAC machine for Army Ordnance. It was contemplated by the Moore School that expenses incurred in the testing of the ENIAC machine by the Moore School would be charged against the 4926 contract rather than the 1706 contract. Goldstine, as Army Ordnance representative at the Moore School, agreed to approve bills for services under the 1706 contract in connection with the operation of the ENIAC machine by Army Ordnance for the period beginning December 1, 1945. Both the Moore School and Army Ordnance representatives considered that the ENIAC machine was being operated rather than tested after November, 1945.

2.1.3.14 In April of 1946, Dr. Travis, the then Director of Research at the Moore School, explained to Dean Pender that the Army was not charged under the 1706 contract in November, 1945, but was charged for December because in November the Moore School engineers had still been testing the ENIAC machine.

2.1.3.15 Formal documentary confirmation of acceptance of the ENIAC machine by Army Ordnance occurred after the University of Pennsylvania, on June 4, 1946, noted that the Government had been using the machine since December, 1945, and requested formal acceptance of the ENIAC, machine so that the final payment to the University could be made.

2.1.3.16 Although formal acceptance of the ENIAC machine was not actually documented until July 25, 1946, the ENIAC machine was at all times after December 10, 1945, in the custody, dominion and control of Army Ordnance.

2.1.4 The two-accumulator ENIAC system, called a "small ENIAC," embodied "the invention" of the automatic electronic digital computer, and was both on sale and sold to Army Ordnance prior to the critical date.

2.1.4.1 The two-accumulator ENIAC system was constructed, fully tested and sucessfully operated by July, 1944.

2.1.4.2 The requirement contained in the 4926 contract that all equipment completed prior to the termination of each contract period was to be delivered to the Government F.O.B., floor of contractor's plant, was fully understood and complied with by the parties to the contract. All contract payments required to be made by the Government to the contractor pursuant to the 4926 contrac were made by March, 1944, for work during the period ending December 31, 1943; by September, 1944, for the period ending June 30, 1944; and by August, 1945, for the period ending December 31, 1944.

2.1.4.3 Prior to July 3, 1944, the team at the University of Pennsylvania had completed the construction of the two-accumulator ENIAC system comprising two accumulator units, a cycling unit and associated power supplies. The two-accumulator ENIAC system was successfully employed in mid-1944 to solve the second order differential equations for a sine wave and for a simple exponential at the same operating speed used in the ENIAC machine and disclosed in the ENIAC patent.

2.1.4.4 The tests on the two-accumulator ENIAC system were in essence a successful test of the fundamental principles of design of the ENIAC machine.

2.1.4.5 The two-accumulator ENIAC system was an electronic numerical integrator and computer. According to the ENIAC project progress reports, the two-accumulator system constituted a small ENIAC machine.

2.1.4.6 The 4926 contract did not require the two-accumulator ENIAC system or the larger 20-accumulator ENIAC machine to perform at any particular operating speed.

2.1.4.7 During the course of the prosecution of the ENIAC patent application, the completion and successful operation of the two-accumulator ENIAC system during mid-1944 was asserted by the applicants, Eckert and Mauchly, to embody fully and constitute an actual reduction to practice of the invention claimed in the ENIAC patent application.

2.1.4.8 Any improvements to the two-accumulator system which were completed subsequent to June 30, 1944, and prior to the end of 1944, were also on

sale and sold to Army Ordnance more than one year prior to the filing date of the ENIAC patent application.

2.1.5 The ENIAC machine, disclosed and claimed in the ENIAC patent, was constructed, fully tested and successfully operated in December, 1945, and was also both on sale and sold to Army Ordnance more than one year prior to the filing date of the ENIAC patent application.

2.1.5.1 By mid-1944, when the two accumulator units were completed and successfully operating in the two-accumulator ENIAC system, the final design for the 20-accumulator ENIAC machine was essentially completed and frozen.

2.1.5.2 The completion and successful operation of the two-accumulator ENIAC system was relied upon by the Government in its decision to authorize Supplement 4 to the 4926 contract for work on the EDVAC, and this constituted a commercialization of the ENIAC invention embodied in the two-accumulator system.

2.1.5.3 Eckert and Mauchly, after mid-1944, devoted some of their time to the development of an advanced computer system known as the EDVAC.

2.1.5.4 Supplement 5 of the 4926 contract, executed in mid-January, 1945, subsequent to the construction, successful operation, delivery of and payment for the two-accumulator system as it existed on June 30, 1944, provided for the completion of the 20-accumulator ENIAC "pilot model."

2.1.5.5 By early December, 1945, the entire ENIAC machine was completed and in operation, the various units having already been individually tested, and the Government had assumed custody, dominion and control over its use and operation.

2.1.5.6 The entire ENIAC machine was placed on sale or sold at the time it was completed and surrendered to the custody, dominion and control of the Government at the Moore School in December, 1945.

2.1.5.7 Supplement 7 of the 4926 contract required delivery of the pilot model by December 31, 1945. There were no supplements to the 4926 contract which extended the delivery date of the ENIAC machine beyond December 31, 1945. The entire ENIAC machine was sold to the Government at the time of its December, 1945, completion, pursuant to the terms of Supplement 7 to the 4926 contract.

2.1.5.8 Neither the 4926 contract nor any of its supplements contained any specifications to be met other than the delivery of a Final Report and delivery of the ENIAC machine. The 4926 contract and its supplements did not require that the ENIAC machine pass any performance test.

2.1.5.9 In June, 1946, Donald S. Murray, Assistant Comptroller of the University of Pennsylvania, wrote to Army Ordnance and requested that it formally accept the ENIAC machine because it had been in use by Army Ordnance since December, 1945.

2.1.5.10 The decision to document a formal acceptance of the ENIAC machine was made at a conference held June 11, 1946. It was decided that an Ordnance employee would, for purposes of transfer of property accountability within Ordnance, furnish certification to the Philadelphia Ordnance District inspector that the ENIAC machine had been completed and received on behalf of Army Ordnance's Ballistic Research Laboratory. This was also desired to accompany change order 10 which validated, after the fact, the December, 1945, actual delivery of the ENIAC machine F.O.B., floor of the contractor's plant.

2.1.6 The subject matter disclosed and claimed by the ENIAC patent was contained in the Final Report on the ENIAC, which embodied all results of the ENIAC work under the 4926 contract, and that Final Report was delivered to and formally accepted by Army Ordnance prior to the critical date.

2.1.6.1 The 4926 contract also required the delivery to the Government of a Final Report.

2.1.6.2 The ENIAC Final Report required by the contract was completed and delivered to the Government and formally accepted as conforming requirements by June 6, 1946.

2.1.6.3 The Final Report contains a written description of the invention claimed by the ENIAC patent in at least as great detail as the patent specification which was based on it.

2.1.7 The ENIAC machine was constructed and "the invention" which it embodied was completed, reduced to practice in operative form, and therefore ready for patenting, by December, 1945.

2.1.7.1 The ENIAC machine, when it was used to perform the Los Alamos calculations in 1945, was being used for its intended purpose and gave correct answers to problems. Any experimental stage was passed prior to December, 1945.

2.1.7.2 Eckert and Mauchly, in eight affidavits prepared between 1951 and 1955 and submitted to the Patent Office in connection with the prosecution of the ENIAC patent application, swore that the reduction to practice of "the invention" of the ENIAC patent had occurred on or prior to December 10, 1945.

2.1.7.3 In his testimony in 1954 in Patent Office Interference 85,809 with the Williams patent of Bell Laboratories, Eckert, in answer to a question by his own attorney as to whether the Los Alamos "problem" was satisfactorily worked out on the ENIAC machine, stated:

"Yes.

"The problem consisted of several hundred runs. Each run in itself lasted perhaps 20 minutes. Each of these runs were related to the next run so that the previous run had to be satisfactorily completed before the next run could be undertaken.

"Each run was in fact run twice, the results punched into punch cards, the punch cards put into a reproducer, what is known as a comparing board, and the two runs checked against one another for consistency. Then each few runs a test problem which ascertained that the machine was functioning correctly was also run, so that the problems were in effect tested for self-consistency, errors of a permanent nature, and errors of an intermittent nature.

"Incidentally, this problem was sufficiently classified that Dr. Goldstine and myself, plus the two men from the other agency who ran the problem, were the only people who were aware of the nature of the problem at the Moore School. The Dean of the school and other members of the staff, no one else knew the nature of this problem. And I have never been told that this problem was declassified."

2.1.7.4 In his testimony in Patent Office Interference 85,809 in 1954, Mauchly described the use of the ENIAC machine in 1945 as follows:

They actually worked with the computer and began setting it up in December, and if I recall correctly they obtained some useful results before the end of the year.

Q That is before the end of 1945?

A Yes.

Q Thereafter was the machine in more or less continuous use solving problems?

A Yes. * * *

2.1.7.5 The brief submitted on behalf of Eckert and Mauchly in Interference 85,809 adopted the testimony of Eckert and Mauchly. For example, the testimony of Eckert was summarized in 1955 as follows:

"The completed machine was first used for working problems approximately two and one-half years after they started, on balistic problems and on another classified problem as to which the subject matter is still classified. That problem took considerably over one month, the actual running time of the problem being somewhere around two weeks. The difficulties were not with the machine but with the mathematical nature of the problem and mistakes of the mathematicians who had designed the problem for the machine (REC 641 to 643 Q122 to 126). The problem consisted of three simultaneous partial differential equations with an empirical function in the kernel of the equation (REC 643, 644 Q121, 128)."

2.1.7.6 The Court has considered the representations of Eckert, Mauchly and their attorneys, who also represented SR's predecessors, before the Patent Office during the procurement of the ENIAC patent, and has balanced them against the trial testimony here of Eckert and Mauchly. The more nearly contemporaneous statements made before the Patent Office, many years nearer to the events and prior to the emergence of public use and on sale as substantial issues, are binding admissions entitled to be credited.

2.1.8 The Moore School's procurement of further government-financed work to design and build an EDVAC automatic electronic digital computer, utilizing the know-how and competence derived from the ENIAC invention subject matter, was a commercialization of "the invention" constituting an on sale within the meaning of 35 U.S.C. § 102(b).

2.1.8.1 Subsequent to the successful completion and reduction to practice of the two-accumulator ENIAC system in July, 1944, a Supplement 4 to the 4926 contract was negotiated to begin development and construction of a new machine, EDVAC, which would handle problems beyond the scope of ENIAC.

2.1.8.2 As stated in the Progress Report on the EDVAC, describing work done under Supplement 4 of the 4926 contract, EDVAC and ENIAC are both electronic digital computing machines.

2.1.8.3 Subsequent to the successful completion, reduction to practice and commencement of practical use of the ENIAC machine by its purchaser, Army Ordnance, in December, 1945, a new separate contract for the EDVAC was negotiated in April 1946, and given the designation W–36–034–ORD7593 (hereinafter referred to as the 7593 contract).

2.1.8.4 The completion both of the two-accumulator ENIAC system and of the ENIAC machine was used to demonstrate the capability of the Moore School and its team to build electronic digital computers such as ENIAC or EDVAC. That demonstrated capability resulted in the award of Supplement 4 of the 4926 contract and the award of the 7593 contract (both relating to the EDVAC) to the Moore School.

2.1.8.5 Supplement 4 to the 4296 contract and the 7593 contract were each an exploiting or commercialization by the Moore School of the ENIAC invention subject matter, the "electronic digital computer," after it was ready for patenting and prior to the critical date.

2.2 Implicit in this finding (2.1) is that Mauchly and Eckert obviously attempted to commercialize the ENIAC prior to the critical date.

2.2.1 Findings 1.1 8 to 1.1.8.19 above as to public use are pertinent, and reference thereto is hereby made in connection with the statutory bar of "on sale."

2.3 The standards of proof stated (in 1.2, 1.3, and 1.4) above apply here.

3. Atanasoff

3.1 The subject matter of one or more claims of the ENIAC was derived from Atanasoff, and the invention claimed in the ENIAC was derived from Atanasoff.

3.1.1 SR and ISD are bound by their representation in support of the counterclaim herein that the invention claimed in the ENIAC patent is broadly "the invention of the Automatic Electronic Digital Computer."

3.1.2 Eckert and Mauchly did not themselves first invent the automatic electronic digital computer, but instead derived that subject matter from one Dr. John Vincent Atanasoff.

3.1.3 Although not necessary to the finding of derivation of "the invention" of the ENIAC patent, Honeywell has proved that the claimed subject matter of the ENIAC patent relied on in support of the counterclaim herein is not patentable over the subject matter derived by Mauchly from Atanasoff. As a representative example, Honeywell has shown that the subject matter of detailed claims 88 and 89 of the ENIAC patent corresponds to the work of Atanasoff which was known to Mauchly before any effort pertinent to the ENIAC machine or patent began.

3.1.4 Between 1937 and 1942, Atanasoff, then a professor of physics and mathematics at Iowa State College, Ames, Iowa, developed and built an automatic electronic digital computer for solving large systems of simultaneous linear algebraic equations.

3.1.5 In December, 1939, Atanasoff completed and reduced to practice his basic conception in the form of an operating breadboard model of a computing machine.

3.1.6 This breadboard model machine, constructed with the assistance of a graduate student, Clifford Berry, permitted the various components of the machine to be tested under actual operating conditions.

3.1.7 The breadboard model established the soundness of the basic principles of design, and Atanasoff and Berry began the construction of a prototype or pilot model, capable of solving with a high degree of accuracy a system of as many as 29 simultaneous equations having 29 unknowns.

3.1.8 By August, 1940, in connection with efforts and further funding, Atanasoff prepared a comprehensive manuscript which fully described the principles of his machine, including detail design features.

3.1.9 By the time the manuscript was prepared in August, 1940, construction of the machine, destined to be termed in this litigation the Atanasoff-Berry computer or "ABC," was already far advanced.

3.1.10 The description contained in the manuscript was adequate to enable one of ordinary skill in electronics at that time to make and use an ABC computer.

3.1.11 The manuscript was studied by experts in the art of aids to mathematical computation, who recommended its financial support, and these recommendations resulted in a grant of funds by Research Corporation for the ABC's continued construction.

3.1.12 In December, 1940, Atanasoff first met Mauchly while attending a meeting of the American Association for the Advancement of Science in Philadelphia, and generally informed Mauchly about the computing machine which was under construction at Iowa State College. Because of Mauchly's expression of interest in the machine and its principles, Atanasoff invited Mauchly to come to Ames, Iowa, to learn more about the computer.

3.1.13 After correspondence on the subject with Atanasoff, Mauchly went to Ames, Iowa, as a houseguest of Atanasoff for several days, where he discussed the ABC as well as other ideas of Atanasoff's relating to the computing art.

3.1.14 Mauchly was given an apportunity to read, and did read, but was not permitted to take with him, a copy of the comprehensive manuscript which Atanasoff had prepared in August, 1940.

3.1.15. At the time of Mauchly's visit, although the ABC was not entirely complete, its construction was sufficiently well advanced so that the principles of its operation, including detail design features, was explained and demonstrated to Mauchly.

3.1.16 The discussions Mauchly had with both Atanasoff and Berry while at Ames were free and open and no significant information concerning the machine's theory, design, construction, use or operation was withheld.

3.1.17 Prior to his visit to Ames, Iowa, Mauchly had been broadly interested in electrical analog calculating devices, but had not conceived an automatic electronic digital computer.

3.1.18 As a result of this visit, the discussions of Mauchly with Atanasoff and Berry, the demonstrations, and the review of the manuscript, Mauchly derived from the ABC "the invention of the automatic electronic digital computer" claimed in the ENIAC patent.

3.1.19 The Court has heard the testimony at trial of both Atanasoff and Mauchly, and finds the testimony of Atanasoff with respect to the knowledge and information derived by Mauchly to be credible.

4. Inventors

4.1 The application for the ENIAC patent was filed by M and E, whom I find to be the inventors.

4.1.1 On June 26, 1947, Eckert and Mauchly (sometimes abbreviated herein as "M and E") filed U.S. patent application S.N. 757,158, later designated Sperry Rand Case-EM-6, describing the ENIAC machine "which embodies our invention."

4.1.2. On June 19, 1947, Eckert and Mauchly executed an oath as the sole co-inventors in support of the ENIAC patent application.

4.1.3 Honeywell contends that because the ENIAC machine was the product of a team effort comprising the intermingled contributions of all of the personnel on the ENIAC project team, others were improperly excluded as co-inventors.

4.1.4 SR and ISD contend that Honeywell has not met its burden of proving that persons other than Eckert and Mauchly were co-inventors on a claim-by-claim basis.

4.1.5 As set forth in Sections 1 through 3 of these Findings, the claimed invention embodied in the ENIAC machine was barred from patentability by prior public use and on sale and "the invention" claimed in the ENIAC patent was derived from Atanasoff. Although Eckert and Mauchly were therefore not entitled to patent that claimed invention, they have not been shown to have incorrectly excluded as named co-inventors, other members of the ENIAC team.

4.2 I am inclined to be of the view that the work on the ENIAC was a group or team effort and that the inventive contributions were made by Sharpless, Burks, Shaw, and others.

4.2.1 Arthur W. Burks made major contributions to the design of the accumulator and multiplier of ENIAC and signed at least 77 drawings.

4.2.2 T. K. Sharpless made major contributions to the design of the high-speed multiplier, the initiating and cycling units, and the accumulator of ENIAC and signed at least 83 drawings.

4.2.3 Robert F. Shaw contributed to the design of the function table, the accumulator, the master programmer, the initiating unit, the constant transmitter and the printer of ENIAC and signed at least 103 drawings.

4.2.4 John H. Davis made contributions to the design of the accumulator, the initiating unit and the cycling unit of ENIAC and signed at least 56 drawings.

4.2.5 Frank Mural made contributions to the design of the accumulators and the master programmer of ENIAC and signed at least 124 drawings.

4.2.6 Chuan Chu made contributions to the design of the divider/square rooter of ENIAC and signed at least 28 drawings.

4.2.7 In early 1944, S. B. Williams, employed by Bell Telephone Laboratories, conceived a design for the temporary storage of input information in relays which was disclosed to the ENIAC design team and later incorporated in the ENIAC machine.

4.2.8 IBM provided the input and output equipment and the interface circuits for the ENIAC machine during the first half of 1944.

4.2.9 The design of the ENIAC machine required contributions from many engineers at the Moore School who were a part of the ENIAC design team.

4.3 There is, however, a failure of proof as to specific contributions by others than M and E.

4.3.1 Notwithstanding Findings 4.2.1 to 4.2.9 above, Honeywell has not offered evidence applying claims of the ENIAC patent specifically to the respective and particular contributions made by each member of the ENIAC project team in the absence of which the court is unable to determine such specific matters.

4.3.2 In the summer of 1941, John W. Mauchly (Mauchly") and John Presper Eckert, Jr. ("Eckert") met at the Moore School of Electrical Engineering at the University of Pennsylvania and began a series of discussions, conversations and interchanges about electronic computing .

4.3.3 In August 1942, Mauchly, by then a member of the faculty of the Moore School, prepared a memorandum, setting out some of the ideas he and Eckert, a graduate student, had discussed on the subject of electronic computing.

4.3.4 In March 1943, the memorandum, which had been circulated to Brainerd and Chambers of the Moore School came to the attention of the Office of the Chief of Ordnance of the United States Army through Captain Herman Goldstine and Colonel Paul Gillon, both of whom thought it was a very exciting proposal.

4.3.5 Thereafter, the Moore School submitted a formal proposal under the aegis of Prof. John G. Brainerd, the more technical parts of which were written by Eckert and Mauchly, and the Government and the Trustees of the University of Pennsylvania entered into a contract for "research and experimental work in connection with the development of an electronic numerical integrator and computer" [ENIAC, an acronym coined by Col. Gillon].

4.3.6 Even before the contract had been awarded, Eckert and Mauchly began to develop things to be assigned to others to work on when the latter were assigned to the ENIAC project.

4.3.7 Eckert was made the laboratory supervisor and chief engineer of the ENIAC project by Brainerd; and Mauchly, along with Eckert, was placed in charge of engineering and testing.

4.3.8 A group of engineers and other supporting personnel was assembled to work with Eckert and Mauchly on the ENIAC project. Included in this group were: Arthur W. Burks, Joseph Chedaker, J. Chuan Chu, James Cummings, John H. Davis, Harry Gail, Robert Michael, Frank Mural, Thomas Kite Sharpless and Robert Findley Shaw.

4.3.9 Eckert and Mauchly explained to the engineers what was to be done and assigned them specific jobs.

4.3.10 While others on the project were working on and building test equipment, Eckert and Mauchly were working out the details of what the ENIAC machine should be.

4.3.11 Those working on the ENIAC project, under Eckert and Mauchly, were employees of the Moore School who assisted in the engineering work, construction and testing of the ENIAC machine.

4.3.12 During the project, Eckert and Mauchly continued to refine and clarify the conception of the group as to how the computing system was going to be implemented and realized.

4.3.13 By September 27, 1944, Eckert and Mauchly's conception of the ENIAC machine was complete.

4.3.14 On September 27, 1944, Eckert wrote a letter to all the engineers on the project advising them that any patents "must be taken out in the name or names of the inventors in order to be valid" and asking the engineers to write out and subit to him or Mauchly any claims to which they believed they were entitled.

4.3.15 None of the responses to Eckert's letter identify or claim any inventive contribution to anything claimed in the ENIAC patent.

4.3.16 There is no evidence that any project engineer or anyone else, other than Eckert and Mauchly, identified or asserted any inventive contribution to the

inventive subject matter claimed in the ENIAC patent until some 20 years after Eckert sent his September 27, 1944 letter.

4.3.17 Contemporary documents and publicity described only Eckert and Mauchly as the co-inventors.

4.3.18 Both Army Ordnance and Moore School officials knew that Eckert and Mauchly were naming themselves as inventors and that the patent application for the ENIAC patent was being prepared in the names of only Eckert and Mauchly but there is no evidence that other engineers knew of this or of the nature or scope of the claims finally made.

4.3.19 Eckert and Mauchly and the project engineers who testified, knew of no one, other than Eckert and Mauchly, who made any inventive contribution to the inventive subject matter claimed in the ENIAC patent.

4.3.20 Honeywell has not proved that any of the following are inventors or co-inventors of the inventive subject matter claimed in the ENIAC patent: Arthur W. Burks, Joseph Shedaker, J. Chuan Chu, James Cummings, John H. Davis, Harry Gail, Robert Michael, Frank Mural, Thomas Kite Sharpless, Robert Findley Shaw, Arthur H. Dickinson, John Wheeler, S. B. Williams, and Adele Goldstine.

4.3.21 U.S. Patent #3,120,606 (the ENIAC patent) issued on February 4, 1964. Eckert and Mauchly are the named inventors.

[4] 4.3.22 The ENIAC patent is presumptively valid and the named inventors, Eckert and Mauchly, are presumed to be the true and actual inventors.

4.3.23 Honeywell has a heavy burden to overcome the presumption of validity.

4.3.24 Honeywell has failed to establish by a preponderance of the evidence that there were any inventors or co-inventors of the inventive subject matter claimed in the ENIAC patent, other than Eckert and Mauchly.

4.3.25 To meet its burden Honeywell would have had to establish that there were other inventors of the subject matter of the claims of the ENIAC patent. "Each claim of a patent * * * shall be presumed valid independently of the validity of other claims * * *."

[5] 4.3.26 The work, experiments, and suggestions of others—not rising to the level of invention—in assisting Eckert and Mauchly in carrying out the conception does not entitle such others to be treated as inventors or co-inventors of the subject matter claimed in the ENIAC patent.

4.3.27 The group of engineers and support personnel working on the ENIAC project, other than Eckert and Mauchly, did not make any specifically proven inventive contribution to the inventive subject matter claimed in the ENIAC patent.

[6] 4.3.28 The failure of an alleged inventor or co-inventor to make a claim of inventorship at the time Eckert and Mauchly were being publicized as the inventors is evidence permitting the inference that the alleged inventor's or co-inventor's assertions are not sustainable.

5. Claims Not Anticipated

5.1 The claims in the ENIAC patent were not anticipated by or obvious in view of the (1) RCA Reports and the Morton and Flory Patents, (2) Andrews, et al., Patent, (3) Mumma Patent, and (4) claim 142 was not anticipated by or obvious in view of the Phelps Patent.

(1) (a) RCA Reports

5.1.1 The RCA Report of February 26, 1942 was an internal RCA report.

5.1.2 The RCA Report of April 22, 1942 was a classified report of the U.S. Government.

5.1.3 Both reports concern a proposed rate device which was to determine the average rate of speed of an aircraft.

5.1.4 The proposed rate device was to be a special purpose tool which was to be very slow and whose only arithmetic function was to be subtraction.

5.1.5 Plaintiff's witness, Dr. Jan Rajchman, a prominent scientist employed by RCA during the time when the reports were prepared, and who also was familiar with the ENIAC machine, was familiar with the reports (his name appears on them) and the work they applied to.

5.1.6 The rate device was never completed or used.

5.1.7 Despite Rajchman's apparent knowledge of the reports and the work they encompassed, he nevertheless recognized that the ENIAC machine was a pioneering enterprise, a machine of enormous consequence that had an enormous influence in the field.

5.1.8 The RCA Reports do not describe any operative embodiment and do not describe a programmable computer.

5.1.9 There is no substantial equivalence, in whole or in part, between the RCA rate device and the apparatus described and claimed in the ENIAC patent.

5.1.10 In each of Claims 65, 69, 75, 78, 109, 36, and 122, there are one or more express limitations which cannot be applied to the rate device as described.

5.1.11 The rate device has utility as an all-electronic computer, capable of performing a computation for whatever purpose.

5.1.12 Claim 109 cannot be applied to the rate device since Claim 109 has several limitations and requirements not met by the rate device.

5.1.13 Each of Claims 36 and 122 are inapplicable to the rate device since each claim has several limitations and requirements not met by the rate device.

5.1.14 Claim 69 cannot be applied to the rate device since Claim 69 has several limitations and requirements not met by the rate device.

5.1.15 Claim 65 also cannot be applied to the rate device since Claim 65 has several limitations and requirements not met by the rate device.

5.1.16 Claim 78 cannot be applied to the rate device since Claim 78 has several limitations and requirements not met by the rate device.

5.1.17 Claim 75 cannot be applied to the rate device since Claim 75 has several limitations and requirements not met by the rate device.

(*1*) (*b*) *Morton et al. Patent*

5.1.18 The Morton et al. patent No. 2,435,841 was considered by the Patent Office during the prosecution of the application for the ENIAC patent.

5.1.19 The Morton et al. patent discloses a function generator for use in a single problem type of apparatus intended to be usable in a fire control device.

5.1.20 The device of the Morton et al. patent is inoperative.

5.1.21 Each of Claims 69, 65, 78, 75 of the ENIAC patent deals with various features of a memory arrangement, which in the ENIAC patent embodiment, includes a function table.

5.1.22 Claim 78 cannot be applied to the Morton et al. patent since Claim 78 has several limitations and requirements not met by the patent.

5.1.23 Claim 69 cannot be applied to the Morton et al. patent since Claim 69 has several limitations and requirements not met by the patent.

5.1.24 Each of Claims 65 and 75 also cannot be applied to the Morton et al. patent since each claim has at least one limitation and requirement not met by the patent.

(*1*) (*c*) *Flory et al. Patent*

5.1.25 The Flory et al. patent No. 2,404,047 was considered by the Patent Office during the prosecution of the application for the ENIAC patent.

5.1.26 The Flory et al. patent does not disclose the subject matter of Claims 69, 65, 78, and 75 of the ENIAC patent.

(2) *Andrews et al. Patent*

5.1.27 The Andrews et al, patent No. 2,977,048 concerns a relay computer.

5.1.28 The Andrews et al, patent application, assigned to Bell Telephone Laboratories (BTL), was in interference in the Patent Office with the ENIAC patent application and thus was considered by the Patent Office.

5.1.29 Andrews, one of the inventors named in the Andrews et al. patent, reviewed the ENIAC patent after it issued and concluded that Claim 36, among others, could not be applied to any BTL relay computer. The Andrews et al. patent disclosed one of the BTL relay computers.

5.1.30 Claim 36 relates to the interruption of the operation of the apparatus which controls the sequencing of a computer such that its operation may be stepped manually at a slow rate through steps which it ordinarily would proceed through synchronously at electronic speeds. In contrast, the Andrews relay machine always operates asynchronously.

5.1.31 Claim 36 cannot be applied to the Andrews et al. patent since Claim 36 has several limitations and requirements not met by the Andrews et al. patent.

5.1.32 Claim 122 relates to the ability to stop the computer during its automatic sequencing and to advance it either one add time or one pulse time per depression of a switch and to display, for example, with lamps, quantities contained in the accumulators and other units. In contrast, the Andrews et al. relay machine is asynchronous and thus cannot provide pulse signals in sequence and in

definitive groups. The Andrews et al. patent does not even show an arrangement for producing discrete signals in sequence and in definitive groups as required by Claim 122.

5.1.33 Claim 122 cannot be applied to the Andrews et al. patent since Claim 122 has several limitations and requirements not met by the Andrews et al. patent.

(3) Mumma Patent

5.1.34 The Mumma patent No. 2,422,428 discloses a non-programmable console calculator apparatus which can perform a single addition, a single subtraction, or a single multiplication only.

5.1.35 The Mumma patent was considered by the Patent Office in the prosecution of the ENIAC patent application as early as March of 1950, when it was first cited by the examiner, and it appeared as a reference on the printed ENIAC patent when it issued.

5.1.36 Claims 52, 55, 56 and 57 relate to certain features for programming a data processor. In contrast, the calculator apparatus disclosed in the Mumma patent fails to meet these claims since it is not an electronic digital computer so arranged as to allow one to program it to carry out a series of mathematical operations.

5.1.37 In the Mumma calculator apparatus, data is entered manually on a set of keyboards by key depression and another button must be pressed for a multiplication, for example, to occur; and thus Mumma's calculator only performs one operation per key depression and pushing of a start button.

5.1.38 Mumma himself acknowledged that the tally impulse generator of the device disclosed in the Mumma patent merely keeps track of a single value and thus involves no selectivity such as is called for by Claims 56 and 57 of the ENIAC patent.

5.1.39 Claim 56, and also Claim 57 which is dependent on Claim 56, cannot be applied to the Mumma patent because each claim has several limitations and requirements not met by the Mumma patent.

5.1.40 Claims 52 and 55, which also relate to programming, cannot be applied to the Mumma patent since each claim has several limitations and requirements not met by the Mumma patent.

5.1.41 Claim 109 cannot be applied to the Mumma patent since it has several limitations and requirements not met by the Mumma patent.

5.1.42 The Mumma patent cannot meet the language of either Claim 8 or Claim 9, each of which calls for more than one arithmetic operation. Mumma himself recognized that his apparatus fails in this respect; additionally, each of these claims has several other limitations and requirements not met by the Mumma patent.

(4) Claim 142 of the Phelps Patent

5.1.43 The Phelps patent No. 2,624,507 concerns a multiplying device and not a programmable electronic digital computer.

5.1.44 The Phelps patent discloses two embodiments and Honeywell relied on the first embodiment which discloses a relay multiplier.

5.1.45 An IBM patent attorney, while preparing the application for the Phelps patent, suggested the second embodiment which is the electronic version.

5.1.46 In contrast to that which is described and claimed in the ENIAC patent, the device disclosed in the Phelps patent cannot chain together a series of multiplications to be carried out in a desired order or otherwise, much less can it perform multiplications and other operations in accordance with a program.

5.1.47 Claim 142 of the ENIAC patent relates to a timing mechanism having a stepping circuit.

5.1.48 Claim 142 requires, among other things, an output signal which must be a single pulse repeated regularly but with a lower frequency or a frequency related to the source frequency. In contrast the Phelps patent does not disclose a signal, but rather a burst of ten pulses occurring and spaced from another burst of ten pulses, and does not disclose a stepping circuit.

5.1.49 Claim 142 cannot be applied to the Phelps patent since Claim 142 has several limitations and requirements not met by the Phelps patent.

5.1.50 The application for the Phelps patent was filed in the Patent Office on September 27, 1945.

5.1.51 Honeywell has not met its burden of proving that any of Claims 69, 65, 78, 75, 109, 36, or 122 of the ENIAC patent is identically disclosed in either or both RCA reports.

5.1.52 Honeywell has not met its burden of proving that any of Claims 69, 65, 78, 75, 109, 36, or 122 of the ENIAC patent is anticipated by either or both RCA reports.

5.1.53 Honeywell has not met its burden of proving that any of Claims 69, 65, 78, 75, 109, 36, or 122 of the ENIAC patent was obvious in view of anything described in the RCA reports.

5.1.54 Honeywell has not met its burden of proving that any of Claims 69, 65, 78, or 75 of the ENIAC patent is anticipated by the Morton et al. patent or the Flory et al. patent.

5.1.55 Honeywell has not met its burden of proving that any of Claims 69, 65, 78, or 75 of the ENIAC patent was obvious in view of the Morton et al. patent or the Flory et al. patent.

5.1.56 Honeywell has not met its burden of proving that either Claim 36 or Claim 122 of the ENIAC patent is identically anticipated by the Andrews et al. patent.

5.1.57 Honeywell has not met its burden of proving that either Claim 36 or Claim 122 of the ENIAC patent is obvious in view of the Andrews et al. patent.

5.1.58 Honeywell has not met its burden of proving that any of Claims 8, 9, 52, 55, 56, 57, or 109 of the ENIAC patent is identically anticipated by the Mumma patent.

5.1.59 Honeywell has not met its burden of proving that any of Claims 8, 9, 52, 55, 56, 57, or 109 of the ENIAC patent is obvious in view of the Mumma patent.

5.1.60 Honeywell has not met its burden of proving that Claim 142 of the ENIAC patent is anticipated by the Phelps patent.

5.1.61 Honeywell has not met its burden of proving that Claim 142 is obvious in view of the Phelps patent.

6. Claims Anticipated

6.1 Claims 83, 86, and 88 were anticipated by or obvious in view of the Phelps patent.

6.1.1 During the 1930's IBM experimented with the use of electronic counting devices as high-speed substitutes for the mechanical adding wheels used in their commercial products. IBM engineers developed and built an electronic multiplier and tests were successfully carried out at its rated punching speed in November 1942.

6.1.2 The electronic multipling apparatus developed and constructed at IBM was later described in detail in a patent application filed by an IBM engineer, Phelps, on September 27, 1945, now U.S. Patent No. 2,624,507. Although the Phelps patent did not issue until January 6, 1953, the same disclosure by Phelps issued earlier in the form of the equivalent British Patent No. 616,962 on January 28, 1949.

6.1.3 The IBM multiplier consisted of a mechanical card feeding, reading and punching unit electrically coupled to a separate electronic multiplying unit. The only mechanical part of the IBM electronic multiplier was that necessary to read and punch the cards, the arithmetic operations of the multiplication being performed at electronic speed.

6.1.4 Factors punched on an IBM card were read in the reading unit, the multiplication was performed in the electronic computing unit, and the result was then punched on the same card as it passed through the punching station. The electronic multiplier was pulse-responsive and operated under the control of a first timer at a rate of 8,000 pulses per second while the peripheral card handling equipment was operated by a second timer at the rate of 23 pulses per second.

6.1.5 The Patent Office rejected claims of the ENIAC patent application as "obviously fully met" by the British Phelps disclosure. Examiner Pokotilow advised Eckert and Mauchly's attorney, William D. Hall, that the Phelps disclosure was "very pertinent to the claims in the ENIAC application." The Phelps patent was overcome as prior art only after the filing by Eckert and Mauchly of an affidavit representing that the invention was made by them before the filing date of the IBM application for the Phelps patent.

6.1.6 Notwithstanding the affidavit which "overcame" the application filing date of the Phelps patent as prior art in the Patent Office, Phelps had in fact made the invention of the rejected ENIAC claims before the ENIAC project work had even begun, and such invention was not thereafter abandoned, suppressed or concealed.

6.1.7 Claims 83, 86 and 88, shown to be readable in all material respects on the prior Phelps work, are thereafter barred from patentability by the provisions of 35 U.S.C. §§ 102(g) and 103.

7. The First Draft Report

7.1 The First Draft Report was a printed publication prior to the critical date, and was an anticipatory publication, and contains an enabling disclosure of the ENIAC.

7.1.1 In 1944, Dr. John von Neumann, a mathematician of international distinction, was serving as a consultant with the Ballistics Research Laboratory of the Army Ordnance. During this same period, he also was serving as scientific advisor and counselor to the Los Alamos Laboratories in nuclear weapons research matters.

7.1.1.1 Dr. Herman H. Goldstine, of the Ballistics Research Laboratory ("BLR"), sparked van Neumann's interest in the ENIAC during a train ride which the two took to Philadelphia in late summer 1944. Almost immediately thereafter, von Neumann viewed the ENIAC two-accumulator system in operation and became deeply involved in the ENIAC project, meeting frequently with Eckert, Mauchly, Burks and Goldstine.

7.1.1.2 Von Neumann's dual roles BLR and Los Alamos led him to recommend the use of high-speed computing machines as an aid to the computations of the Los Alamos Laboratories and to Dr. Edward Teller in particular.

7.1.1.3 Goldstine and von Neumann agreed that a report should be prepared to summarize the general ideas regarding the art of high-speed automatic electronic digital computers discussed at the Moore School and, as a result, von Neumann prepared a document entitled "First Draft of a Report on the EDVAC". This First Draft Report was authored by von Neumann between February and June of 1945 and was a substantial and major part of the total report he intended to write.

7.1.1.4 Von Neumann's First Draft Report, a comprehensive document of one hundred pages, contains fifteen chapters, each having subsections, and deals in detail with the logical organization and makeup of a high-speed automatic electronic digital computer. Included in the report are definitions of report terminology and a chapter devoted to the procedure used by the author for discussion. Specific hardware was not detailed, in order to avoid governmental security classification and, in Eckert's and Mauchly's words, to avoid raising engineering problems which might detract from the logical considerations under discussion.

7.1.2 Goldstine, with the approval of von Neumann, circulated a large number of mimeographed copies of the First Draft Report for the express purpose of making the knowledge therein publicly available to advance the state of the computer art.

7.1.2.1 The purpose of early publication of the First Draft Report was to further the development of the arm of building high-speed automatic electronic digital computers, and to advance scientific engineering thinking on this subject as widely and as early as feasible.

7.1.2.2 After its completion in mimeographed form, the Draft Report, which was unclassified with the knowledge and approval of Army Ordnance, was immediately distributed to members of the technical staff in the Moore School, and thereafter, to other persons in the United States and England variously representing the Ballistics Research Laboratory; the Princeton Institute for Advanced Study; the Applied Mathematics Panel on the National Defense Research Committee; the Radiation Laboratory at the Massachusetts Institute of Technology; Scientific Computing Ltd. in London, England; United States Army Ordnance; United States Naval Ordnance; the Computing Laboratory at Cambridge University in England; the Mathematics Institute at New York University; and the University of Chicago.

7.1.2.3. The First Draft Report was a printed publication, within the meaning of 35 U.S.C. § 102, by June 30, 1945, prior to the ENIAC patent critical date.

7.1.2.4 The distribution of the First Draft Report had an important influence on the continuing development of electronic computers.

7.1.2.5 The computing system described by von Neumann in the First Draft Report featured the use of the computer's high-speed memory to store not only numbers but operating instructions as well. Called "stored programming," this concept introduced new dimensions in the speed, flexibility and usefulness of automatic electronic digital computers.

7.1.3 While the First Draft Report does not include a detailed disclosure of the specific hardware to mechanize the machine disclosed within the report, it does include a disclosure sufficient to teach one skilled in the art how to

accomplish the logical control of a high-speed automatic digital computing system.

7.1.3.1 Each of the logic elements (referred to as "organs") disclosed in the First Draft Report had existing physical counterparts and/or could have been constructed by the exercise of ordinary skill in the art at the time the report was published, before the critical date for the ENIAC patent. Experts in the field testified at trial that the report is, and was at the time of its publication sufficient to enable persons skilled in the art to make and use the computer set forth in the report.

7.1.3.2 Plaintiff's tutorial expert witness, Kenneth Rose, read and understood the First Draft Report and presented an in-court demonstration model of the stored program technique taught in the First Draft Report.

7.1.3.3 The Court also heard the testimony of plaintiff's expert witness Paul Winsor, who studied the First Draft Report extensively with a view toward determining whether or not a computer could have been constructed at the time (1945) from the report's teachings. He examined the wartime technology available, when the report was published, to construct the elements referred to in the report. As a result of his study, Winsor concluded, and this Court concurs, that the report was sufficient to enable persons skilled in the art in 1945 to construct the computer set forth therein with the available technology. Moreover, documents written by persons concerned with the report, contemporaneous with its publication, corroborate this testimony. For example, ENIAC patent attorney Church commented on the First Draft Report.

> "I think the broad conception is there and to one skilled in the art it is sufficient to put them on the road of accomplishing a development."

Von Neumann's attorney Townsend agreed, despite the fact that his conclusion prejudiced any possible patent rights his client might have sought. The Court credits this testimony.

7.1.4 The claims of the ENIAC patent asserted in this suit are anticipated by or obvious in view of the First Draft Report. The Court reaches this finding through an independent study of the record, including the testimony of plaintiff's expert, Winsor.

7.1.4.1 Claims 8, 9, 52, 55, 56, 57, 65, 75 and 78 are each anticipated by the First Draft Report.

7.1.4.2 The inventive subject matter of "the Automatic Electronic Digital Computer" is either anticipated by or obvious in view of the First Draft Report.

7.1.5 The finding that the First Draft Report disclosed the basic concepts of the ENIAC invention is supported by statements of those who considered the same issue prior to the time the ENIAC application was filed.

7.1.5.1 The applicants for the ENIAC patent were informed before the ENIAC patent application was filed, by Army Ordnance patent lawyers who prepared and prosecuted the ENIAC application, that the First Draft Report was a barring publication. [See also Findings 13.31 et seq. herein]

7.1.5.2 Defendants have admitted that by April 8, 1947, Eckert and Mauchly had been advised that the Army Ordnance patent lawyers considered the First Draft Report to be a printed publication within the meaning of the patent statute.

7.1.5.3 On April 8, 1947, a meeting including the patentees, Eckert and Mauchly, and Libman (the principal active lawyer who prepared and filed the ENIAC application on behalf of Eckert and Mauchly) and Church (later an attorney of record for Eckert and Mauchly in the ENIAC application), was held to consider the impact of the First Draft Report on the patentability of inventions theretofore made by them. During this meeting, Church stated:

> "It is our firm belief from the facts that we have now that this report of yours dated 30 June 1945 is a publication and will prohibit you or anyone else from obtaining a patent on anything it discloses because it has been published more than a year and statute provides that if you don't file disclosures within a year it constitutes a bar to patenting that device."

7.1.5.4 During the April 8, 1947 meeting, Eckert admitted that the report was a barring publication, and it was clearly and unequivocally established, in the presence of the patentees Eckert and Mauchly and their patent lawyers Church and Libman, that the report was an enabling publication dated more than one year before the ENIAC patent application was filed.

7.1.6 It is apparent from the distribution list of the June 30, 1945 First Draft Report that Mauchly was charged with the duty of delivering the report to the Army Ordnance Patent Department. The list also makes clear the report's relevance to Eckert's and Mauchly's patent matters. On the list, it is stated:

"Dr. J. W. Mauchly (2) (to be given to patent lawyer and patent Dept. of Ordnance)"

There is no evidence that Mauchly ever carried out this duty, and the Frst Draft Report did not come to the attention of the Army Ordnance Patent Department until it was later submitted by von Neumann.

8. The AMP Report and Burks Article

8.1 The AMP Report and Burks Article state printed publications prior to the critical date.

8.1.1 The AMP Report No. 171.2R, portions of which were copied into the ENIAC application, is a general description of the ENIAC machine. Its title indicates its purpose: "Description of the ENIAC and Complaints on Electronic Digital Computing Machines."

8.1.1.1 The AMP report was prepared for the Applied Mathematics Panel of the National Defense Research Committee at the request of Dr. Brainerd of the Moore School.

8.1.1.2 The report is sixty-eight pages in length, and includes a description of the ENIAC machine with drawings and appendixes discussing the arithmetic operation, programming, and construction data of the ENIAC machine.

8.1.1.3 The report was joint authored by Brainerd, Goldstine, Eckert and Mauchly.

8.1.2 In excess of one hundred copies of the AMP Report were printed, separately numbered, and distributed during or prior to March, 1946, to numerous persons skilled in the art at that time. This distribution was made with the approval of Army Ordnance.

8.1.3 The persons receiving the AMP report represented or were affiliated with such institutions as Ballistics Research Laboratory, University of Chicago, Princeton Institute for Advanced Study, Los Alamos Scientific Laboratory, the National Academy of Sciences, University of Michigan, University of Vermont, RCA, New York University and University of Pennsylvania.

8.1.4 The AMP Report, as distributed, was marked "Restricted." However, this classification permitted dissemination of material to anyone for official purposes and was, at the time of the publication of the AMP Report, the lowest level of Government security classification. In any event, the general principles of design and operational and functional characteristics of the ENIAC were declassified from military security by Army Ordnance on December 7, 1945, and the "Restricted" stamp failed to prevent actual publication.

8.1.5 The ENIAC patent was, in substantial part, based upon and copied from the AMP Report. The report's stated purpose was "to give the reader a rather complete account of the general features of the ENIAC * * *", and had the intended effect. For example, one of its readers, Major Sterne, received "a much clearer idea of the working employment of the ENIAC." Sterne also stated that the report dealt "clearly with the theory of the design of digital computing devices," and the Court concurs in this contemporaneous comment.

8.1.6 The Burks article, entitled "Super Electronic Computing Machine," is a seven-page description of the ENIAC machine having as its stated purpose "to explain how the ENIAC solves mathematical problems electronically." Included in the article are photographs of a layout of the ENIAC machine and of the initiating and cycling units. Also shown are the master programmer and accumulator, and a diagram of the actual connections between units of the ENIAC machine to solve a representative differential equation. Separate schematic diagrams of various logic gates (e.g., a flip-flop, "and" gate and "or" gate employing vacuum tubes) and of a typical ENIAC circuit showing the interconnection of two program control circuits with an accumulator, also are set forth and discussed in the article. The text of the article sets forth and discusses the basic ENIAC units including arithmetic units, the control units, and the input/output equipment.

8.1.7 Although the Burks Article appeared in the July, 1946 issue of Electronics Industry (a date after the critical date), the credible evidence shows that the article was first published on June 25, 1946, before the critical date.

[7] 8.1.8 The fact of publication of the Burks article on this date is evidenced, pursuant to 17 U.S.C. § 209, by the certificate of copyright registration for the article which states: "This issue was published on the 25 day of June 1946" by the Guide Printing Company, New York, N.Y.

8.2 Plaintiff has not, however, proved the readability of the claims of the ENIAC on either the AMP Report or the Burks Article.

8.2.1 Honeywell did not prove that the AMP report describes to those skilled in the art how to make and use the invention disclosed in Claim 142 or any other claim of the ENIAC patent.

8.2.2 The Burks Article was considered by the Patent Office and the patent examiner found that it did not anticipate the claims of the ENIAC patent application in interference.

8.2.3 Honeywell did not prove that the Burks Article describes to those skilled in the art how to make and use the invention disclosed in Claim 8 or any other claim of the ENIAC patent.

8.2.4 Honeywell offered no testimony to show readability of any of the claims of the ENIAC patent on the AMP report or the Burks Article.

8.2.5 Honeywell did not meet its burden of proving that the inventive subject matter claimed in the ENIAC patent was anticipated by or obvious in view of the AMP report or that any claims of the ENIAC patent read on the AMP report.

8.2.6 Honeywell did not meet its burden of proving that the inventive subject matter of Claim 8 or any other claim of the ENIAC patent was anticipated by or obvious in view of the Burks Article or that any of the claims of the ENIAC patent read on the Burks Article.

9. Description

9.1 The description and disclosure in the ENIAC are sufficient.

9.1.1 The description and disclosure in the ENIAC patent are sufficient to enable one skilled in the art to practice the invention defined by the claims.

[8] 9.1.2 There is a presumption that the Patent Office reviewed the ENIAC patent application for sufficiency of its description and that the patent's disclosure is sufficient to teach one skilled in the art how to practice the invention.

9.1.3 Honeywell did not meet its burden of proving that the disclosure and description of the ENIAC patent are insufficient.

[9] 9.1.4 It is not necessary that the patent description describe all possible embodiments of the invention.

10. Pulse

10.1 The claims of the ENIAC which use the word pulse and which were covered by the May 20, 1963 amendment redefining the term pulse are invalid.

10.1.1 Both the ENIAC Patent as issued in 1964 and the application for the patent as originally filed in 1947 contain claims which employ the term "pulse." That term was a defining element of the claims and was of material importance to the determination of their patentability.

10.1.1.1 The original application specification described a synchronized computer using coordinated "pulses" as a characterizing part of the description of the invention. The term was expressly defined for purposes of the description of, and the claims to, the invention as follows:

> "A pulse is a positive or negative change in potential which has a duration of about two to five microseconds (μ sec.)." [A "microsecond" is one millionth of a second.]

The lengthy specification is replete with detailed operational descriptions designating the pulses employed as being of 2 microseconds or longer duration.

10.1.1.2 There is no indication of any recognition by the applicants, either in the original application for patent as filed or in the ENIAC patent as issued, that pulses having less than two microseconds duration could be used in a computer, or that higher speed operation would result from the use of such pulses.

10.1.1.3 The patentability of the ENIAC claims employing the term "pulse," over such prior art as the Harvard Mark I computer system, depended upon material representations of electronic high speed made to the Patent Office. The term used in the claims as originally presented upon the basis of the 1947 disclosure was a material one.

10.1.1.4. SR's attorneys repeatedly manifested their awareness that the term "pulse" in the ENIAC claims was limited by the definition of the term in the application as filed.

10.1.1.5 During the case of Sperry Rand et al. v. Bell Telephone Laboratories, Inc., SR, Eckert and Mauchly represented to the Court that the word "pulse" as used in the ENIAC application, was limited to a duration of 2 to 5 microseconds.

10.1.1.6 As late as December 1962, SR's atorney, Hall, recognized that in the ENIAC application, "* * * the claims use the word 'pulses,' and the specification at page 66 defines this word as referring to changes of potential of duration on the order of two to five microseconds."

10.1.1.7 In December 1962, Hall recognized that this definition was "something of very critical character" and that "many modern computers operate with pulses shorter than two microseconds."

10.1.2 During the period from 1947 to 1963, the state of the art of electronic computers advanced dramatically. The contributions of numerous others in the electronic industry, including Honeywell, had produced speeds of operation many orders of magnitude faster than that of the ENIAC machine.

10.1.2.1 For example, a modern day CDC computer is about two thousand times faster than the ENIAC machine.

10.1.2.2 During 1960 and 1961, Honeywell marketed the H–800 computer which used pulses having a duration of less than 0.25 microsceonds.

10.1.2.3 At the time of the filing of the ENIAC patent application in 1947, the ENIAC machine had already been obsoleted by more advanced planning, such as that described for example in the von Neumann First Draft Report. Eckert and Mauchly knew this.

10.1.3 In an amendment to the ENIAC patent application, filed on May 20, 1963, by SR's patent lawyer, Hall, the original definition of the term "pulse" was changed by a broadening addition, as follows:

> "Within the meaning of the appended claims "pulse" will be construed to mean a change or excursion in potential or current which has a duration not exceeding about five microseconds."

10.1.3.1 By this change, the lower limit of the original speed range (two microseconds) was effectively eliminated, thereby rendering the original claims for a circa-1947 computer readable on the circa-1963 computer technology of others, no matter how much faster.

10.1.3.2 Hall knew that the use of shorter pulses, now covered by the new definition, had been made possible by the intervening advances of others in the computing art.

10.1.3.3. There is evidence that Eckert and Mauchly did not read the 1963 Amendment before it was filed, and were not consulted about this change in definition.

10.1.4 The 1963 amendment to broaden the scope of all "pulse" claims was unreasonably delayed, and was not merely a logical development of the original application but rather an exigent afterthought to capture the subsequent contributions of others already in the public domain.

10.1.5 The "pulse" claims are invalid because (1) they are directed to an invention which had not theretofore been claimed in the application, and (2) the claimed invention had been in public use more than one year before the claims were presented.

10.1.6 The prior rights intervening between 1947 and 1963, by reason of the widespread manufacture, use and sale of computers of vastly greater speed than the two to five microsecond pulse characteristic of the ENIAC machine disclosed and claimed by the ENIAC patent application as filed, render the broadening amendment of May 20, 1963 as improper "late claiming" of the invention thereby defined.

10.1.7 ENIAC patent claims 8, 9, 52, 65, 83, 86, 88, 109 and 122 which use the term "pulse", and claim 36 which uses the equivalent term "impulse" are invalid; also, since the word "signal" is defined by defendants as a "pulse", claims containing such word are equivalently invalid, e.g., 69, 75, 78, 142.

[10] .1 Where the applicant does not originally assert claims which are added later by amendment and the subject matter of such late claims is disclosed or in general use and applicant stands by to await developments in the industry before asserting them, there is an unreasonable delay and neglect on the applicant's part rendering such late claims invalid.

[11] .2 Where a late-filed amendment of the patent specification is important enough to constitute the basis for alleged patentability, the amendment constitutes new matter and cannot in fact be a basis for patentability.

[12] .3 The long delay of a patentee in adding broadened claims to a patent application warrants an inference that such claims were added as an afterthought and not as a logical development of the original application, and where the subject matter of the later claims was in public use more than one year before such claims very first introduced, such claims are invalid.

[13] .4 The repeated entry into interferences, resulting in long delays incident to their determination, affords no just excuse for the failure of a patent applicant to assert broader claims at an earlier date. Long delay in coming to the point with new and broader or different claims strongly confirms that the final determination to do so was an exigent afterthought, rather than a logical development of the original application.

[14] .5 An applicant for patent cannot enlarge his pending application in such a manner as to embrace and include for the first time the essential elements of an article, device, or structure which has been in public use or on sale more than one year prior thereto, and a patent obtained in that manner does not represent patentable invention, but is mere appropriation of the inventive skills of others.

[15] .6 Courts must regard with disfavor any attempts to enlarge the scope of an application once filed, the effect of which would be to enable the patentee to appropriate other inventions made prior to such alteration, or to appropriate that which has, in the meantime, gone into public use.

11. Delay

11.1 The ENAIC application was filed in 1947 and issued in 1964.

11.1.1 The application for the ENIAC patent was filed in the Patent Office on June 26, 1947.

11.1.2 The ENIAC patent contains 91 sheets of drawings and 232 columns of specifications and claims. There are 148 claims.

11.1.3 The ENIAC patent application and patent describe the ENAIC machine which was a pioneering achievement.

11.1.4 Patent applications on pioneering achievements are said to be involved more frequently in interferences than other inventions, particularly if the patent application is pending over a substantial period, because other people may learn generally about it and move into the field.

11.1.5 During 1949, counsel for E and M agreed to keep patent cases such as EM–1 pending in the interest of taking into account during their prosecution the interim developments of others following their filing; the same view was expressed in 1959 by Hall.

11.1.6 The amendment of May 20, 1963, with respect to the term "pulse" was an abuse of the long pendency of the ENIAC patent application.

11.2 The complaint in SR v. BTL was filed in November, 1955, a one day trial was held in March, 1962, and the District Court decision followed in September, 1962.

11.2.1 The trial was based upon a stipulated submission of documentary evidence and briefs, and no testimony was presented in open court.

11.2.2 The court was afforded no opportunity to judge witness credibility on the basis of manner and demeanor.

11.3 Plaintiff claims that defendant SR and its counsel intentionally and unreasonably delayed proceedings before the Patent Office and the courts by deliberate action taken through deliberate lack of action.

11.3.1 This Court found a prima facie showing of deliberate delay upon the testimony of Honeywell's expert witness, Professor James B. Gambrell.

11.4 the first interference was filed more than 3½ years after the filing of the application.

11.4.1 In March 1951, while the application for the ENIAC patent was being prosecuted, the first (No. 85,131) of eleven interferences was declared in the Patent Office.

11.4.2 Interference No. 85,131 was declared following the copying of claims by Eckert and Mauchly from NCR's Mumma patent No. 2,495,075.

11.4.3 The interference was dissolved after Eckert and Mauchly filed an abandonment of the contest.

11.5 Many of the interferences filed were unwarranted.

11.5.1 Interferences are proceedings in the Patent Office to determine who, between two or more parties, is entitled to priority of invention. Before an interference is declared the Patent Office must determine that there is sufficient common subject matter claimed by the parties to warrant declaring the interference.

11.5.2 Defendants instigated numerous interferences by copying claims of patents on devices developed by competitors.

11.5.3 The first interference was concluded by June 14, 1951.

11.5.4 The second interference was declared in May 1951 and was concluded in the fall of 1951.

11.5.5 From 1951 through 1957, defendants copied 156 claims from competitors' patents in order to initiate interference proceedings. 152 of these claims were copied from patents based on applications filed subsequent to the ENIAC application, and resulted in the setting up of numerous interference proceedings involving NCR, BTL, Stromberg-Carlson, IBM, and Clary Corp.

11.5.6 When the interferences were ultimately terminated, the Patent Office held that 147 of the 152 claims were for improvements to which defendants had no legitimate claims. With respect to many of the 147 claims, the Patent Office held that there was no support for them in the ENIAC patent application.

11.5.7 The issuance of the ENIAC patent was delayed by these interferences.

11.5.7.1 There was no intentional delay during the first two interferences.

11.5.8 The third interference, No. 85,809, began in May 1952 as a result of Bell Telephone Laboratories' (BTL's) copying of two claims from the ENIAC patent application.

11.5.8.1 The third interference involved the question whether or not, as to Claims 39 and 42 of the ENIAC patent application (Claims 8 and 11 of ENIAC patent), Eckert and Mauchly were entitled to priority over Samuel B. Williams, whose patent application No. 22,784 was assigned to BTL.

11.5.8.2 The Board of Patent Interferences awarded priority to Williams (BTL) on September 29, 1955, over 9 months after the final hearing.

11.5.8.3 There was no intentional or undue delay during Interference No. 85809 in the Patent Office, especially in view of the complexity of the case, and it probably moved more expeditiously than might have been expected.

11.5.9 The remaining interferences were declared subsequent to Interference No. 85809 and terminated prior to September 6, 1962 when the United States District Court of the Southern District of New York handed down its decision in a litigation growing out of the third interference.

11.6 Defendants failed to obtain the services of counsel with the time or interest in pursuing a matter which defendants considered important.

11.6.1 The subject matter of SR v. BTL case, the ENIAC application and the Williams patent, was complex and required large amounts of time.

11.6.2 SR recognized that a team effort was required in order to prepare the SR v. BTL case for trial within a reasonable period of time.

11.6.3 The aggregate time devoted to the SR v. BTL case by all of the SR attorneys during the first six years of the litigation averaged substantially less than the reasonable billing time of a single attorney.

11.7 Deliberately extending the expiration of a monopoly is a serious violation of the Constitution and the patent laws.

11.7.1 Intentional delay by an applicant for patent invalidates the patent.

11.7.2 The only legitimate purpose of an interference proceeding is determining the question of priority of inventorship.

11.8 In the SR v. BTL suit plaintiff's counsel for much of six years failed to adequately prepare for trial.

11.8.1 On November 25, 1955, within the allotted 60 day period, SR filed a civil action under 35 U.S.C. Section 146 in the United States District Court of the Southern District of New York to overturn the decision of the Board of Patent Interferences.

11.8.2 From January, 1957 until October, 1961, Sperry Rand's chief trial counsel for the SR v. BTL case conducted interparty discovery only when:

.1 he was faced with the necessity ". . . because the case might be on the dismissal calendar";

.2 he faced a court-imposed deadline; or

.3 in the case of depositions, the health of a witness of advanced age (80) was of concern (Williams), and a distant witness happened to be passing through town (Huskey).

11.8.3 Between the commencement of the action and the trial in March 1962, inside counsel and other personnel at SR as well as outside counsel from New York, Philadelphia, and Washington were less than diligent in obtaining formal and informal discovery, preparing and answering interrogatories, taking depositions, securing affidavits, working with fact and expert witnesses, researching the law, learning about the extremely complex electronic subject matter, conducting negotiations for simplification of procedure in the case, and generally preparing the case for trial.

11.8.4 The outside attorneys who worked on this case for SR included: C. Blake Townsend, William D. Hall, Carroll G. Harper, Nelson Moore, Robert Kosinski, Elliott Pollock, Zachary T. Wobensmith II, Reynolds Brown, Max L. Libman, and Mr. Hussey.

11.8.5 The inside attorneys and personnel who worked on the case for SR included: John P. Dority, C. A. Norton, Joseph Forman, L. Etlinger, Louis Altman, Francis McNamara, C. E. McTiernan, Marshall Truex, C. C. English, Jerry Light, and Dr. Throckmorton.

11.8.6 SR also had at least two outside experts, Dr. Stibitz and Mrs. Loveday, working part-time on the electronic aspects of the case with Stibitz hired to work approximately 50% of his time. Stibitz wrote a number of reports for and consulted on many occasions with counsel for SR in order to aid them with various technical issues in the case, including the question of the operativeness of the Williams (BTL) patent.

11.8.7 SR's New York counsel had billed SR approximately $120,000 for its work from the fall of 1955 through the fall of 1961, the latter date being some six months prior to the trial before Judge Dawson.

11.8.8 Carroll Harper, a young lawyer working under C. Blake Townsend, SR's lead counsel, spent approximately 3,000 hours on the case.

11.8.9 William D. Hall, SR's Washington counsel, testified that he began spending 50% of his time on ENIAC matters including SR in August 1955, and by mid 1960, when all the interferences and IBM public use proceedings had concluded, Hall said he was spending 50% of his time on SR.

11.8.10 Judge Cashin, Judge Palmieri, Chief Judge Clancy, and Judge Dawson of the United States District Court for the Southern District of New York encouraged the parties' efforts toward settlement and/or a simplified procedure in this complex case.

11.8.11 On December 10, 1958, SR made an application to Chief Judge Clancy for the appointment of a single judge and in that application SR stated in its concluding paragraph:

"In view of the nature and complexity of the subject-matter, the necessity for detail and prolonged preparation and pretrial proceedings, and the probable length of time which will be required for trial, it is believed that the designation of a single Judge to hear all further proceedings in this case will expedite considerably the resolution of the controversy and will materially reduce the burden upon this Court.

11.8.12 On December 17, 1958, Chief Judge Clancy assigned the case to the Honorable Archie O. Dawson "for all purposes including trial."

11.8.13 The issuance of the ENIAC patent was delayed by Sperry Rand's failure diligently to prepare the SR v. BTL case for trial.

11.9 Plaintiff's (SR) management was in part at fault because of unnecessary and unreasonable delays in carrying on settlement negotiations.

11.9.1 SR allowed negotiations for an overall cross-licensing arrangement with BTL and Western Electric to extend over a period of more than seven years.

11.9.1.1 The priority dispute of the SR v. BTL case had begun in 1952, at the instigation of BTL, by the declaration of Patent Office interference proceeding No. 85,809.

11.9.1.2 By April 30, 1954, SR recognized that it would eventually endeavor to perfect a cross-licensing arrangement with BTL.

11.9.1.3 The cross-licensing arrangement was completed on July 1, 1961.

11.9.2 SR's unnecessary and unreasonable delay of the SR v. BTL case was suited to the convenience of its overall cross-licensing negotiations.

11.9.2.1 As late as 1957, BTL urged that no action or consideration be taken in the case until the parties first consummated an overall cross-license including other patent rights.

11.9.2.2 SR's counsel, Townsend, contacted BTL's counsel, Pugh, to make sure that he "was not coasting along in a 'fool's paradise' by taking no further action in this case pending the outcome of the present negotiations."

11.9.2.3 BTL assured SR that inactivity by SR pending such negotiations would not be urged by BTL to constitute unjustified delay or laches.

11.9.2.4 For example, on November 12, 1959, Towsend asked McNamara, Vice President and General Counsel of defendants, how negotiations were progressing, because he and Pugh agreed that Judge Dawson "* * * may take some drastic action" in setting the case for trial. On November 19, 1959, McNamara requested Townsend to "hold this in abeyance pending our present negotiations with Western Electric on an overall license in disignated fields including the

data processing field." In a follow-up letter dated November 20, 1959, Towsend expressed his understanding of McNamara's instructions as follows:

"I note that you wish to hold this matter in abeyance pending your present negotiations with Western Electric.

"This will put me in a position to deal with Mr. Pough if he calls again."

11.9.2.5 By March, 1960, SR's counsel, Townsend, advised the court that:

.1 pre-trial preparations have not yet been completed;

.2 BTL has not yet commenced its discovery;

.3 discussion of a possible settlement still continues between the parties;

.4 it is impossible to say when the case will actually be ready for trial; and

.5 pre-trial hearings would be premature at this time in view thereof.

11.10 Despite six years of inadequate preparation, a District Court must force a trial.

11.10.1 Judge Dawson wrote to counsel about the status of the case on March 14, 1960 and held pretrial conferences on July 1, 1960, December 2, 1960, June 12, 1961 and June 30, 1961.

11.10.2 On July 1, 1960, Judge Dawson held a pretrial conference:

"The Court: * * * I called this conference because this case was filed in this court almost five years ago. It is one of the oldest cases untried in this court, and I want to know where we are going, how soon we are going to be ready for trial and what we have to do to get ready for trial in this case.

"* * * I want to find out where we go from here because this is the sort of thing that creates the criticism in Washington of this court. When a case is dragging around for five years and does not go to trial, they say the court is not doing its work.

"* * * I think by November 1, if you put the pressure on, you can have everything done. By then this case will have been in this court about five years. So I think in five years' time any depositions can have been taken. As a matter of fact, if this was anything other than one of these involved patent cases, I would dismiss it right now for lack of prosecution, because no case should be instituted and then require a five-year wait before it is ready for trial."

11.10.3 Judge Dawson was "a very competent judge" who was "prone to getting his cases tried."

11.11 The kind of trial resorted to in desperation by counsel and the court produced a clearly incorrect result.

11.11.1 About September 27, 1961, the parties entered into a cross-license agreement dated as of July 1, 1961. Thereafter, on November 1, 1961, the parties filed with the court a stipulation and order narrowing issues for submission of evidence through documents.

11.11.1.1 On November 1, 1961, Judge Dawson approved a stipulation and order for a simplified procedure "(i)n the interest of simplifying and expediting the trial of the above civil action, to lessen the amount of work and the expense required in the presentation of proof and to materially shorten the court time required * * *"

11.11.1.2 The November 1, 1961 stipulation and order provided for testimony to be submitted in the form of affidavits, depositions, or oral testimony as the parties might elect. Each party was given the right to crossexamine by deposition any affiants of the other party.

11.11.2 On March 6, 1962, a one-day trial was held. The trial constituted an oral submission by counsel of stipulated documentary evidence.

11.11.3 Judge Dawson handed down his decision in favor of SR on September 6, 1962. Sperry Rand Corp. v. Bell Telephone Labs., Inc., 208 F. Supp. 598, 135 USPQ 254 (S.D. N.Y. 1962).

11.11.4 The Court of Appeals dismissed BTL's appeal as moot in May 1963. Sperry Rand Corp v. Bell Telephone Labs., Inc., 317 F.2d 491, 137 USPQ 497 (2d Cir. 1963).

11.12 A one or two month trial in the spring of 1962 would have possible eliminated a nine month trial in 1971 and 1972.

11.12.1 Judge Dawson stated that through this stipulation and order of November 1, 1962, "* * * what was originally predicted to be a trial of several months' duration was reduced to a single day * * *. Through the commendable efforts of both parties the issues in this action have been greatly simplified."

11.13 In contrast is the speed with which a substantial number of lawyers acted in 1963 in filing the amendments and the apparent repeated pressure on the Patent Office in 1963 to issue the patent.

11.13.1 During a six-month period in 1962 and 1963, fifteen of Sperry Rand's in-house attorneys spent over 2,000 hours preparing the May 20, 1963 amendment to the ENIAC application.

11.13.1.1 After the Court of Appeals' dismissal in May 1963, SR promptly proceeded with amendments and examiner interviews in the Patent Office in connection with the ENIAC patent application.

11.13.1.2 SR received the Patent Office's Notice of Allowance of the ENIAC patent on December 20, 1963.

11.13.1.3 SR's counsel paid the necessary final fee on that same day although six months was automatically allowed for such payment in 1963–64.

11.13.1.4 The ENIAC patent issued on February 4, 1964.

11.13.2 The effort applied to that single amendment is about as much as Sperry Rand's chief trial counsel for the SR v. BTL case, Townsend, had devoted to the case over the six years of its pendency.

11.14 On the record as a whole (but with reluctance) I find that there was no undue delay in the proceedings before the Patent Office or the District Court.

11.14.1 SR did not exceed any time limits provided either by court order, rule, or statute.

11.14.2 There was no intentional delay in the prosecution of the case of Sperry Rand Corp. v. Bell Telephone Labs.

11.14.3 There was no intentional delay in the issuance of the ENIAC patent.

11.14.4 A party seeking a right under the patent statues may avail himself of all their provisions and courts may not deny him the benefit of a single one.

11.14.5 Honeywell has not met its burden of establishing that there was undue delay in the issuance of the ENIAC patent or that there was any improper conduct on the part of SR or its counsel which caused undue delay.

12. Validity

12.1 A patent shall be presumed to be valid.

12.1.1 This presumption is a statutory one which may be overcome so that a patent is rendered invalid or unenforceable or both.

[17] .1 The rebuttable presumption of validity which attaches to a patent because of 35 U.S.C. § 282 is "a faint one" because Patent Office examination is not adversary and the public is not heard.

.2 The presumption of validity is not accorded great weight in the more recent decisions of the Supreme Court, notwithstanding its positive assertion in the case of Radio Corporation of America v. Radio Engineering Laboratories, Inc.

.3 The presumption may not be used to transmute the products of mechanical skill into patentable inventions, since it is as much the duty of the court to protect the public against having to pay tribute to a patentee who is not in any true sense an inventor or discoverer, as to protect the patent rights of one who is a real inventor.

[18] .4 The presumption is greatly weakened, if not destroyed, where bars to patentability raised in litigation are based on prior art or use which were not before the Patent Office Examiner.

[19] .5 One practical reason for the requirement of absolute honesty and good faith disclosure by an applicant in ex parte Patent Office examination is that even an innocent misrepresentation of facts destroys the presumption of validity.

.6 How strong this presumption may be is debatable in view of the multiplicity of patents issued (over three million by 1964), and the high proportion held invalid when litigated (only one held valid in the 8th Circuit since the Supreme Court's decision in Graham v. John Deere, 1966).

.7 While the patent grant still gives rise to a presumption of validity, the effective force of that presumption has been substantially weakened by the plethora of decisions recognizing "the notorious difference" between the loose standards applied by patent examiners in approving patented unpatentables, and the standards applied by the courts in dispatching patents issued thereunder.

12.2 Plaintiff has overcome the presumption of validity by substantial evidence which is clear and convincing.

12.2.1 SR and ISD assert a broad scope for the ENIAC patent:

.1 "No data processing machine of any consequence * * * in the United States today is being made that does not make use of inventions covered by this patent."

.2 The subject matter of the ENIAC patent is "the invention of the Automatic Electronic Digital Computer."

12.2.2 The substantial, clear and convincing evidence in this case establishes that the entirety of this broad subject matter of the ENIAC patent is not validly

patentable. Patentability has not been created, and the absolute bars to patentability have not been overcome by the ingenuity of expression and the variety of technical language found among the 148 different claims of the ENIAC patent.

12.2.3 The machine disclosed and claimed in the ENIAC patent, and embodying the invention of the patent, was in public use in this country more than one year prior to the filing of the ENIAC patent application, and the ENIAC patent is thereby invalid.

.1 A patent is statutorily barred and, hence invalid, if the invention was in public use in the United States more than one year prior to the date of the application.

[20] .2 The public use bar is based on a fiat of Congress that it is part of the consideration for a patent that the public shall begin to enjoy the disclosure as soon as possible.

[21] .3 The use of an invention by a person other than the inventor, not essential to the completion of the making of the invention by the inventor, is a public use, and the fact that the invention is buried within a machine is irrelevant.

[22] .4 Under limited conditions, where the invention involves the need for public use as the only practical way to test the value of the invention and thereby permit the making of the invention to be completed, the inventor may experiment in public as a special exception to the public use bar.

.5 The experimental exception to public use is a narrow one, and it does not apply in a situation where it is possible to conduct the experiment in private, without the need for public use.

.6 The narrow experimental use exception to the public use bar only lifts the one year statutory rule where the use is by the inventor or persons under his control for the purpose of perfecting the invention.

[23] .7 A patentee's Patent Office Rule 131 affidavit which asserts a completion of the invention in the United States before the filing date of the application fixes the last possible date for "experimental" use.

[24] .8 Where there is no question involved of the inventor's determination of whether the invention worked or how it could be improved, and, as well, where the sole purpose of a demonstration is to show new developments in equipment, which have been proved operational, to the public, such use is public, is in bar of a patent and cannot be forgiven as an experiment.

[25] .9 Where the idea of a machine has been conceived and the conception carried into effect by its construction, which machine is then used or capable of being used for the purpose for which designed, such use is no longer an experiment.

.10 An inventor may not enjoy the best of the two possible worlds of secrecy and legal monopoly: he may not be permitted to use a period of alleged "experimentation" as a competitive tool.

[26] .11 That a device, in public use, is capable of improvement can be said in every case there are few, if any, machines which are not susceptible of further development and improvement; the fact that a machine has not been ultimately perfected at the time it was first in use does not avoid a public use bar.

[27] .12 The policy consideration behind the "public use" doctrine is to stimulate seasonable disclosure of inventions.

[28] A single public use of a patented machine more than a year before application for patent is filed, even without any profit to the inventor, is sufficient to establish a public use bar.

[29] .13 Where a device is publicly demonstrated to members of the public including the press, a compelling inference arises that the demonstration was a public use, was not within the experimental use exception and is a statutory bar to a patent if the demonstration occurred more than one year before an application on the device was filed.

[30] .14 Complete identity of the device in public use with the device as claimed in a patent is not necessary to establish a public use bar. The difference between the device used and that patented must be a patentable one to avoid the bar and an inventor cannot relieve himself from the barring consequences of a public use merely by establishing that the device, installed and used, was imperfect.

12.2.4 The machine disclosed and claimed in the ENIAC patent, and embodying the invention of the patent, was on sale in this country more than one year prior to the filing of the ENIAC patent application, and the ENIAC patent is thereby invalid.

.1 A patent shall be barred if the invention was on sale in the United States more than one year prior to the date of the application for patent in the United States.

[31] .2 "On sale" does not mean an actual accomplished sale but merely activity by the inventor in a commercial exploitation of what he later asserts the power to monopolize.

.3 An express contract for the construction of equipment embodying the principles of the invention covered by a patent may constitute "on sale" despite the fact that no structure has yet been constructed.

.4 For a specific device to be "on sale", it is not necessary that an actual delivery of that device be made but only that the device be ready for delivery.

.5 The placing "on sale" of an invention bars all claims to that invention even though the invention may have been imperfect in a mechanical sense at the time.

.6 The "on sale" provision is not limited to a sale free from secrecy, and security classification imposed by the purchaser or offeree does not toll the operation of the bar.

[32] .7 A prima facie showing that an invention was "on sale" can be overcome only by unequivocal and convincing evidence to the contrary.

12.2.5 Eckert and Mauchly did not themselves first invent "the automatic electronic digital computer," which SR and ISD contend to be subject matter of the ENIAC patent, but instead derived that broad subject matter from Dr. John W. Atanasoff, and the ENIAC patent is thereby invalid.

.1 An application for patent shall be made by the inventor, and shall include an oath in support of the claim of inventorship.

[33] .2 A patent which is applied for by one who is not the inventor, is unauthorized by law and void, and whether taken out in the name of the applicant or of an assignee of his, confers no rights as against the public.

.3 The public grants the patent to the first inventor only; and a patent which credits anyone else with the invention confers no rights against the public and does not authorize the purported patentee to tax the industry for that which was actually contributed to the advancement of the arts by the conception of another.

[34] .4 The utilization of ideas in a device prior to the time of the alleged invention, whether or not the device was subsequently abandoned, is evidence that when those ideas are incorporated in a later development along the same line, they do not amount to invention.

12.2.6 The inventive subject matter of "the automatic electronic digital computer," which SR and ISD contend to be the subject matter of the ENIAC patent, is either anticipated by or obvious in view of the printed publication in this country more than one year prior to the filing of the ENIAC patent application of the von Neumann First Draft of a Report on the EDVAC, and the ENIAC patent is thereby invalid.

.1 A patent shall be barred if the invention was described in a printed publication in this or a foreign country, either before the invention thereof by the applicant or more than one year prior to the date of the application for patent in the United States.

[35] .2 The reproduction of a description of an invention by any copy-making technique capable of enabling wide dissemination of multiple copies evidences sufficient accessibility by the public so as to constitute a "printed publication" within the meaning of the statute.

[36] .3 The statute is based upon the public policy that once an invention has been made accessible to the public through printed publication, it cannot thereafter be withdrawn into a legally sanctioned patent monopoly.

[37] .4 A descriptive document qualifies as a printed publication even where only a single typewritten copy is put on file in the library of a college, because it is the expression of an intent that the fruits of research be available to those of the public who have an interest in the subjetc matter that is determinative of the fact of publication.

[38] .5 Distribution of a small number of copies of a descriptive document to a limited group of individuals skilled in the art, who are outside the distributor's organization, is publication within the meaning of the statute.

.6 A patent may not be obtained though the invention is not identically disclosed or described in the prior art, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious to a person having ordinary skill in the art to which the subject matter pertains.

12.2.7 Each of the 17 ENIAC patent claims representatively asserted in this suit by the counterclaim of ISD is further and specifically invalid on a claim-by-claim basis:

.1 The subject matter set forth in each of the 17 representative claims (8, 9, 36, 52, 55, 56, 57, 65, 69, 75, 78, 83, 86, 88, 109, 122 and 142) was in the public use in this country more than one year before the filing of the ENIAC application.

.2 The subject matter set forth in each of the 17 representative claims was on sale in this country more than a year before the filing of the ENIAC application.

.3 Eckert and Mauchly did not themselves invent the subject matter set forth in at least claims 88 and 90 but instead derived knowledge of that subject matter from John V. Atanasoff.

.4 Claims 83, 86 and 88 are anticipated by U. S. patent No. 2,624,507 issued to Byron Phelps.

.5 Claims 8, 9, 52, 65, 83, 88, 109 and 122 containing the word "pulse," and Claim 36 containing the fully equivalent word "impulse," were improperly broadened in September 1963 to cover a new and previously unexpressed invention for the purpose and with the effect of encompassing subject matter already in the public domain, and are invalid for late claiming.

.6 Claims 8, 9, 52, 55, 56, 57, 65, 69, 75 and 78 are each anticipated by the printed publication in this country more than one year prior to the filing of the ENIAC patent application of the von Neumann First Draft of a Report of the EDVAC.

12.3 I find and conclude that the ENIAC is invalid and unenforceable.

12.3.1 See Findings 1, 2, 3, 7 and 10 above as establishing invalidity.

[39] 12.3.2 Although not made a basis for a finding of undue delay such as to render the ENIAC patent invalid for deliberately extending the expiration of a monopoly, the inherent consequences of delay in issuance due to six years of inadequate preparation by SR and its counsel in the SR v. BTL case, and thereby the proceedings before the Ptaent Office as set out at Finding 11 above, render the ENIAC patent unenforceable.

[40] .1 Where many persons were at work in the same field and had made advances in the art, and where the applicant learns of such work and is aware that his original claims might not cover the real advance made by his competitors an intentional delay in the prosecution of the patent to enable later changes in the specification and claims so that the work of the other inventors might be covered, renders the patent invalid.

[41] .2 The patent laws are founded on public policy to promote the progress of science and the useful arts. The public, therefore, is a most material party to, and should be duly considered in, every application for a patent, securing to the individual a monopoly for a limited time, in consideration for the teaching of the results of the exercise of his genius and skill. But the arts and sciences will certainly not be promoted by giving encouragement to inventors to withhold and conceal their inventions to a time when they may use and apply them to their own exclusive advantage, irrespective of the public benefit, and certainly not if the inventor is allowed to conceal his invention to be brought forward in some later time to thwart and defeat other inventors who have placed the benefit of their inventions within the reach and knowledge of the public.

12.3.3 Although not made a basis for a finding of willful and intentional fraud, the various derelictions of Eckert and Mauchly and their counsel before the Patent Office, as set out at Finding 13 below, render the ENIAC patent unenforceable.

[42] .1 Whether the applicant's misconduct was material in the procurement of the patent is of no consequence. If the conduct of the applicant is reprehensible, it matters not that it was really unnecessary, and the patent is unenforceable.

.2 There is a line between willful and intentional fraud which will invalidate a patent and inequitable conduct which will render it unenforceable; inequitable conduct on the part of an applicant in obtaining a patent is sufficient to dissuade a court of equity from rendering aid in enforcing it.

13. Fraud on Patent Office

[43] 13.1 The claim for damages based on claimed violations of the antitrust laws because of willful and intentional fraud on the Patent Office requires proof by clear and convincing evidence.

13.2 Patent proceedings are largely ex parte in nature.

13.2.1 The Patent Act provides:

The Commissioner shall cause an examination to be made of the application and the alleged new invention; and if on such examination it appears that the applicant is entitled to a patent under the law, the Commissioner shall issue a patent therefor.

Applications for patents shall be kept in confidence by the Patent Office and no information concerning the same shall be given without authority of the applicant or owner unless necessary to carry out the provisions of any Act of Congress or in such special circumstances as may be determined by the Commissioner.

13.3 This has long been an unfortunate situation and should be remedied.

13.3.1 The Patent Reform Act of 1973, introduced on March 22, 1973, by Senator Phillip A. Hart (D-Mich.) of the Patents, Trademarks and Copyrights Subcommittee of the Senate Judiciary Committee, would eliminate ex parte prosecution. In his floor remarks introducing this legislation, Senator Hart said:

The bill recognizes that the patent monopoly grant is a carefully delineated privilege designed to serve the public interest in promoting the progress of science and useful arts and not an unlimited license to the recipient. Let me highlight some of the significant features of the bill.

First, the Patent Office would be made independent divorcing it from the interests of the Commerce Department.

Second, secret ex parte sessions wherein interested parties and a patent examiner decide the patentability of an idea would be replaced with public adversary hearings.

Third, a Public Counsel would be installed in the Patent Office—to argue for the public interest and to make the Office itself simply judge instead of both judge and advocate.

Fourth, the Patent Office is given subpoena, investigative, and research powers so it may independently, and with great assurance, determine the question of patentability before—rather than after—issuance of the patent.

Currently, the Office relies on information supplied by the applicant. Under the present system, the average patent receives a total of about 15 hours of review.

The new procedures would allow a full airing of the facts and hopefully enable the Patent Office to deny patents that today are being found invalid in the courts in such great numbers.

13.4 To obtain a monopoly which can exact tremendous tribute from the public requires complete candor on the part of applicants and their attorneys.

13.4.1 The Patent Office does not have full research facilities of its own, and it has never been intended by Congress that it should; in fact, the Patent Office relies heavily upon research by applicants.

13.4.2 By reason of the nature of an application for patent, the relationship of attorneys to the Patent Office requires the highest degree of candor and good faith; and in its relation to applicants, the Patent Office must rely upon their integrity and deal with them in a spirit of trust and confidence.

[44] 13.4.3 Those who have applications pending with the Patent Office or who are parties to Patent Office proceedings have an uncompromising duty to report to the Patent Office fully and fairly all facts which may affect the patentability of the invention; public interest demands that all such facts be submitted formally or informally to the Patent Office, for it is only in this way that the Patent Office can act to safeguard the public in the first instance against illegal patent monopolies.

13.4.4 Fraud in the procurement of a patent includes not only intentional misrepresentations, but mentional concealment of material facts.

13.5 M and E took oaths stating that they were the sole inventors, that there had been no public use of the ENIAC before the critical date, and that the ENIAC was not on sale before the critical date.

13.5.1 One such oath was the oath of June 19, 1947, which was filed with the ENIAC patent application on June 26, 1947.

13.5.2 Another such oath was the oath with the Rule 131 affidavit filed on September 16, 1963, after Eckert and Mauchly had been made aware, in the IBM attempts to institute Patent Office public use proceedings and in the BTL litigation, that the ENIAC machine had been in public use and on sale prior to the critical date.

13.6 M and E knew of the Los Alamos use of the ENIAC, though permission for its use was not asked of them.

13.6.1 Eckert and Mauchly have been aware since 1945 that the Los Alamos calculations were an important and successful use of the ENIAC machine.

13.6.2 Commencing in 1946, lawyers acting in the interest of Eckert and Mauchly have been aware that, when the Los Alamos calculations were put on the ENIAC machine in 1945, it was the first time that the machine as a whole was being used; that it was fully expected that the problem would be solved; and that it was solved.

13.6.3 Eckert and Mauchly have sworn on behalf of SR and themselves that various ENIAC patent claims were actually reduced to practice at the time of or prior to the use of the ENIAC machine to perform the Los Alamos calculations.

13.6.4 In the brief in BTL interference No. 85,809, submitted in 1954, lawyers for Eckert and Mauchly characterized the Los Alamos calculations as an extensive problem which was successfully worked out on the ENIAC machine.

13.6.5 It was only after the issue of public use of the ENIAC machine had been raised in 1956 and 1959 by the IBM Public Use Petitions that SR reversed the earlier position of claiming reduction to practice at or before the Los Alamos calculations and contended instead that the ENIAC machine and hence the invention it embodied was not reduced to practice until August, 1946.

13.6.6 At the time that SR lawyers drafted affidavits for the signatures of Los Alamos personnel Metropolis and Frankel, which contended that they were not interested in answers to practical problems and had not obtained any useful results, they had already been otherwise informed by the Los Alamos Laboratory that the calculations were in fact a substantial effort which successfully had satisfactorily solved specified problems and that the results did not lie dormant.

13.6.7 The use of the ENIAC machine by the Los Alamos Laboratory personnel was not under the control of Eckert and Mauchly.

13.6.8 Eckert, in sworn testimony in interference No. 85,809, was asked if the Los Alamos problem was satisfactorily worked out on the machine. He said:

"Yes.

"The problem consisted of several hundred runs. Each run in itself lasted perhaps 20 minutes. Each of these runs were related to the next run so that the previous run had to be satisfactorily completed before the next run could be undertaken.

"Each run in fact run twice, the results punched into punch cards, the punch cards put into a reproducer, what is known as a comparing board, and the two runs checked against one another for consistency. Then every few runs a test problem which ascertained that the machine was functioning correctly was also run, so that the problems were in effect tests for self-consistency, errors of a permanent nature, and errors of an intermittent nature. * * *

"Incidentally, this problem was sufficiently classified that Dr. Goldstine and myself, plus the two men from the other agency who ran the problem, were the only people who were aware of the nature of the problem at the Moore School."

13.6.9 Eckert, in sworn testimony in interference No. 85,809 summarized in SR's interference brief, testified that "the difficulties were not with the machine but with the mathematical nature of the problem and the mistakes of the mathematicians who designed the problem for the machine."

13.7 They appear not to have known of the results obtained.

13.8 In view of their lack of knowledge of the problem solved and the results obtained, they may have acted in good faith.

13.9 M and E knew of the public demonstrations in February 1946, and that problems were put on the ENIAC and solved, but may have acted in good faith in this regard in that the circuit designs were classified.

13.9.1 Army Ordnance sufficiently declassified the ENIAC machine prior to the press demonstration, dedication and open house in February, 1946, in order to give wide-spread publicity to the machine so that persons interested in such devices would be allowed to know all details in connection with it.

13.9.2 The original 4926 contract, all supplements and change order thereto, and the ENIAC project were from the inception Government classified "confidential".

13.9.3 The ENIAC and EDVAC projects were still classified "confidential" on October 15, 1945, when a meeting on computing methods and devices was held at the Ballistic Research Laboratory. At the October 15, 1945, BRL meeting, it was stated:

.1 that a number of academic institutions as well as other government agencies were beginning to display the greatest possible interest in new, high-speed computing machines along the lines pioneered by the Ordnance Department;

.2 that in order to be of service to universities and the Navy, as soon as practicable, the ENIAC and EDVAC were to be declassified and all pertinent information on the machines made available to the country at large;

.3 that anything less than a free exchange of information on high-speed computing machines would be detrimental to the best interest of the United States; and

.4 that as soon as the ENIAC was successfully working, its logical and operational characteristics would be completely declassified, and sufficient publicity would be given to the machine in order that those who were interested in such devices would be allowed to know all details in connection with it.

13.9.4 In a December 7, 1945, meeting on ENIAC and EDVAC at the Ballistic Research Laboratory, it was agreed that the ENIAC would be declassified as soon as possible, and detailed plans were made for the dedication ceremony of the ENIAC machine.

13.9.5 Ordnance Committee Memorandum 29904, which was read for record before the Ordnance Committee on December 20, 1945, reclassified the ENIAC project; on January 4, 1946, a copy of Ordnance Committee Memorandum 29904 was sent to Goldstine by Gillon with the explanation that the item would facilitate existing work on publicity for the ENIAC.

13.9.6 In February, 1946, when Army Ordnance held a press demonstration, dedication and open house of the ENIAC machine, persons attending the ceremonies were allowed, by reason of the reclassification of the ENIAC machine, to view it and its operative parts and units in actual problem solving operation and their questions concerning its performance capabilities and design principles were answered.

13.10 M and E knew of the running of the Hartree problem, but again were possibly unaware of the results obtained and may thus have acted in good faith.

13.11 M and E were, of course, bound by the actions of their lawyers.

13.12 There appears to have been suppression of the Hartree notes or letters or results by counsel for applicants who appeared before the Patent Office and the District Court.

13.12.1 In 1961, documents describing details of the Hartree problem were withheld by SR from Bell Telephone Laboratories, and were not offered in evidence before the District Court for the Southern District of New York in SR v. BTL.

13.12.2 On June 24, 1955, SR patent agent Charles English wrote to T. H. Thiemann, in England, seeking his aid in collecting diaries, programming notes, and other such records pertaining to Hartree's 1946 use of the ENIAC machine.

13.12.3 English indicated that this course of action to obtain Hartree's original records was suggested by Hartree "when he discussed the matter with Dr. Mauchly, of this company."

13.12.4 On August 8, 1956, a year after the original inquiry by English, Hartree wrote to SR's London office enclosing: (a) Hartree's original programming sheets, (b) a page of notes attached to the program sheets which Hartree had written in order to point out how the specific information requested could be found on these sheets and (c) a published paper entitled The Laminar Boundary Layer in Compressible Flow, by W. F. Cope and D. R. Hartree, F.R.S., Royal Society of London Philosophical Transactions, Series A (published June 22, 1948, manuscript received May 13, 1947).

13.12.5 On August 27, 1956, the material which had been sent by Hartree was forwarded to patent agent English by John C. Sims, Jr., or SR, with the suggestion that it be in turn forwarded to one of SR's patent attorneys, William D. Hall, at an early date so that Hall could evaluate it in connection with his work on a Patent Office interference involving the ENIAC patent application.

13.12.6 On April 3, 1958, English forwarded the Hartree letter, original notes, and published paper to Hall, stating that Mauchly believed that the problem which Hartree ran on the ENIAC, and which was described in the Hartree/Cope published paper, had been Problem No. 4 on the ENIAC machine.

13.12.7 The programming sheets received by SR and Hall from Hartree described how the ENIAC machine was connected in the spring of 1946 to calculate the null-order functions of Hartree's work; the relevant pages of Hartree's published paper to this effect, as sent by him, had been hand marked by Hartree personally.

13.12.8 Since August 8, 1956, to date, SR has been in possession of these materials supplied by Hartree relative to his use of the ENIAC machine before the critical date.

13.12.9 From 1956 to 1963, SR was in litigation with BTL, and Hall was an attorney of record for SR.

13.12.10 In the 1956-63 SR–BTL litigation, the question of whether or not the ENIAC machine had been in public use, so as to bar the issuance of any valid patent, was in direct controversy.

13.12.11 In the SR–BTL litigation, on November 29, 1960, BTL served upon SR and its individual co-defendants, Mauchly and Eckert, a set of interrogatories, including Interrogatories 15 to 20, specifically seeking information with respect to certain problems, including the Hartree problem "No. 4" run on the ENIAC machine.

13.12.12 The answer to Interrogatories 15 to 20 was given and signed on February 17, 1961, by each of the individuals, Mauchly and Eckert, and an officer of Sperry Rand.

13.12.13 In this answer, SR did not identify either Hartree's published paper as marked by him or his programming sheets and explanatory letter and note, or the correspondence relating to it.

13.12.14 The scope of BTL's Interrogatories 15 to 20 necessarily required the identification of all of these Hartree materials.

13.12.15 On January 14, 1960, Hall filed an opposition brief in the IBM attempted public use proceeding before the Patent Office, attacking the description Goldstine had given of the Hartree problem in an affidavit, although the description was corroborated by the documentation from Hartree then in Hall's possession. Hall charged that Goldstine's description of the Hartree problem was based on hearsay, and that "unfortunately, Hartree is dead, so rebuttal is not easy."

13.12.16 Only certain of the evidence held by SR concerning Hartree's use of the ENIAC machine was placed before Judge Dawson through the affidavits and or deposition testimony of the following: Herman Goldstine, John Holberton, Frances Holberton, Kathleen Mauchly, Jean Bartik, Homer Spence.

13.12.17 SR's advocacy against the Hartree work as a public use of the ENIAC machine was made despite knowledge of facts and possession of unproduced relevant documents to the contrary.

13.13 The record may support the running of other problems of use of the ENIAC before the running of problem No. 9 upon which defendants rely as the first problem run and solved.

13.13.1 For example, in addition to Los Alamos and Hartree, Harry Huskey operated the ENIAC machine in April, 1946, as set out under 1.1.7.8 above.

13.14 It appears that attorney Libman, who was primarily responsible for the preparation of the application, knew in November 1946 that the ENIAC had been in public use since December 10, 1945.

13.14.1 Army Ordnance patent attorneys began consideration of filing ENIAC patent applications in early 1944, and worked on application material pertinent to EDVAC and ENIAC intermittently from 1944 through the June 26, 1947, filing date of the ENIAC application.

13.14.2 On February 25, 1944, Eckert and Brainerd met with Gillon and Majors Windham and Ruestow of the Army Ordnance legal branch to discuss the transmittal of detailed disclosure information for the patenting of ENIAC project inventions; as a result, the Army Ordinance patent branch undertook the preparation of a patent application to cover inventions made under the 4926 contract.

13.14.3 In August, 1944, further ENIAC/EDVAC meetings between Eckert, Mauchly and the Ordnance patent attorneys were held in Washington, and Army Ordnance patent attorney Horace Woodward began preparation of at least one patent application on the ENIAC machine in September 1944; by late 1944, Ordnance patent attorneys had prepared at least two patent application drafts on ENIAC/EDVAC subject matter and delivered them to Mauchly.

13.14.4 On June 28, 1945, Max Libman was assigned by Army Ordnance as the attorney to complete the patent applications which had been started by Woodward more than one year before.

13.14.5 Libman was directed to devote his full time to the preparation of the ENIAC application, and to begin "from scratch" without using the parts of the ENIAC application Woodward had previously prepared.

13.14.6 In addition to the Army Ordnance patent attorneys, Libman and Woodward, Eckert and Mauchly's personal patent counsel, George E. Smith, was also given copies of the ENIAC Final Report so that he could help in preparing the patent application.

13.14.7 In the late fall of 1946, Libman through Kessenich asked the Moore School in supply information indicating when public use of the ENIAC machine began.

13.14.8 The Moore School, in response to the Libman-Kessenich request, informed Army Ordnance and Kessenich, by letter dated November 18, 1946, that successful operation of the ENIAC machine began with the Los Alamos calculations on December 10, 1945.

13.14.9 It would not have been possible for the Army Ordnance Patent Section to have filed the ENIAC patent application prior to December 10, 1946, after receiving the November 18, 1946, answer to the request for public use dates.

13.14.10 Libman nevertheless proceeded on the clearly erroneous assumption that there had been no public use of the ENIAC: he did not interview anyone at the Moore School, or do any further investigating of fact or law but decided there had been no public use on the sole ground that he personally deemed it doubtful that a pilot model of a machine could be in public use.

13.15. Public use was at issue before the Patent Office in two petitions filed by IBM.

13.15.1 One such petition was filed on July 1, 1946.

13.15.2 The second petition was filed on February 20, 1959.

13.16 The first was ruled to be premature and in the second, after an adverse ruling by the assistant commissioner, no further proceedings were had.

13.16.1 See 13.34.5 and 13.34.25, infra.

13.17 The question of public use was also an issue in SR v. BTL, but litigated without any kind of a trial.

13.17.1 Although Patent Office procedings are in general ex parte, the ENIAC patent application was involved in numerous adversary proceedings: eleven interferences, IBM's public use petitions, and the litigation with Bell Telephone Laboratories in the U.S. District Court for the Southern District of New York.

13.17.2 The controversy which led to that trial began in the Patent Office in 1952 over the issue of priority of invention between ENIAC and a 1942 BTL automatic electronic digital computer, and ended in the Southern District of New York with the BTL and SR litigation on the question of public use.

13.17.3 On July 1, 1961, prior to the SR v. BTL trial, Western Electric Company (acting for the Bell System, including BTL) and SR executed a complete cross-license of all their patents and applications (including EDP patents and patent applications).

13.17.4 The Agreement had the effect of mooting BTL's attack on the validity of Sperry Rand's ENIAC patent application and put BTL in a position in which it had nothing to gain and patent protection to lose by establishing the invalidity for the ENIAC patent.

13.17.5 BTL did not pursue the public use issue vigorously in the SR v. BTL case after the execution of the July, 1961, Agreement; at the time when the question of the public use was submitted in the fall of 1961, BTL had no real or legal interest in establishing public use.

13.17.6 BTL's internal memoranda indicate that it desired to complete the SR v. BTL litigation at the least expense and with the least possible amount of effort: BTL submitted its evidence in affidavits and deposition transcripts with no live testimony in open court.

13.17.7 Most of the volume of the stipulated evidence in the SR v. BTL trial did not bear on the public use issue at all, but instead bore on the priority issue which had previously been eliminated from the case by agreement.

13.17.8 After Judge Dawson incorrectly found no public use on the scanty evidence before him, BTL pursued an appeal to the Court of Appeals for the Second Circuit which dismissed it because the case had been rendered moot by the execution of the patent cross-license between Western Electric and Sperry Rand on July 1, 1961.

13.18 Though I have found that the ENIAC was on sale before the critical date and that M and E attempted its commercialization, it may be that M and E acted in good faith in that they did not know what on sale meant.

13.19 The work of Atanasoff was current and was of great importance to M.

13.19.1 Detailed findings and conclusions concerning the work of Atanasoff and John Mauchly's knowledge of that work have previously been set forth under Finding 3, above.

13.19.2 Prior to his visit to Ames, Iowa, Mauchly had been broadly interested in electrical analog calculating devices, but had neither conceived nor built any electronic digital calculating device.

13.19.3 In a letter dated June 29, 1941, to H. Helm Clayton, John Mauchly described Atanasoff's work, and its relationship to Mauchly's prior thinking, as follows:

"Immediately after commencement here, I went out to Iowa State University to see the computing device which a friend of mine is constructing there. His machine, now nearing completion, is electronic in operation, and will solve within a very few minutes any system of linear equations involving no more than

thirty variables. It can be adapted to do the job of the Bush differential analyzer more rapidly than the Bush machine does, and it costs a lot less. My own computing devices use a different principle, more likely to fit small computing jobs."

13.19.4 After his visit with Atanasoff, Mauchly left his employment at Ursinus College and joined the staff of the Moore School of Electrical Engineering at the University of Pennsylvania.

13.19.5 Mauchly took a short course in electronics at the Moore School and then joined the faculty, during which time he began to consider applying his understanding of the new impulse or digital principles he had been taught by Atanasoff.

13.19.6 On September 30, 1941, Mauchly wrote to Atanasoff from the Moore School:

"A number of different ideas have come to me recently anent computing circuits—some of which are more or less hybrids, combining your methods with other things, and some of which are nothing like your machine. The question in my mind is this: Is there any objection, from your point of view, to my building some sort of computer which incorporates some of the features of your machine? For the time being, of course, I shall be lucky to find time and material to do more than merely make exploratory tests of some of my different ideas, with the hope of getting something very speedy, not too costly, etc.

"Ultimately a second question might come up, of course, and that is, in the event that your present design were to hold the field against all challengers, and I got the Moore School interested in having something of the sort, would the way be open for us to build an 'Atanasoff Calculator' (a la Bush analyzer) here?"

13.19.7 Dr. Atanasoff responded that, while he had no qualms about having disclosed his ideas to Mauchly, he did not wish to have his concepts made public until adequate steps had been taken to obtain patent protection for his ideas.

13.20 The latter had further contact with Atanasoff in 1944 and invited him to the public demonstrations in February 1946.

13.20.1 The April, 1943, proposal for the ENIAC contract referred ot the Atanasoff work, but did not identify it.

13.20.2 In August, 1944, Eckert and Mauchly visited with Atanasoff on the same day they began the process of filing patent applications involving subject matters which stemmed from Atanasoff's prior work.

13.20.3 The apparent purpose of this visit to Atanasoff in 1944 was to seek hsi assistance in the perfection of the recirculating delay line memory for EDVAC.

13.20.4 The purpose of Eckert and Mauchly's visit with Ordnance patent lawyers on the same day was to lay plans for making patent claims to ENIAC and EDVAC inventions, including the recirculating memory.

13.20.5 Neither Eckert nor Mauchly disclosed Atanasoff's work to their attorneys prior to filing the ENIAC patent application.

13.21 If Atanasoff had proceeded in 1942 or 1943 to file a patent application, the information in the application would have been available to the Patent Office.

13.21.1 The ABC was described in a definitive manuscript and in a draft patent application specification which was prepared by Clifford Berry but, because it was never filed, the Patent Office had no means by which it could have become aware of the ABC or of Mauchly's prior knowledge of the ABC.

[45] 13.22 Complete candor with and disclosure to the Patent Office is required.

13.23 At the same time, knowledge of the applicant may come from a variety of sources and from many years of education and experience.

13.24 What should be disclosed to the Patent Office as possible sources of invention, prior art or derivation must in some degree be left to the judgment and conscience of the applicant.

13.25 M may in good faith have believed that the monstrous machine he helped create had no relationship to the ABC or Atanasoff.

13.25.1 Mauchly may in good faith have believed that he did not derive the subject matter claimed in the ENIAC patent from Atanasoff. In September, 1944, he wrote a summary of the situation as he then saw it: "I though(t) his (Atanasoff's) machine was very ingenious, but since it was in part mechanical (involving rotating commutators for switching it was not by any means what I had in mind."

13.25.2 Atanasoff saw the ENIAC machine as it existed on October 26, 1945, and in early 1946 extensive publicity was given to the ENIAC project, acknowledging Eckert and Mauchly as the inventors, but Atanasoff did not assert that the ENIAC machine included anything of his until two decades later.

13.25.3 Of the 17 claims of the ENIAC patent at issue in this suit, Honeywell has failed to prove the readability of claims 8, 9, 36, 52, 55, 56, 57, 65, 69, 75, 78, 83, 86, 109, 122 and 142, or any of them, on Atanasoff's machine or any other work of Atanasoff.

13.26 M and E have maintained that they were the sole co-inventors of the ENIAC.

13.26.1 Eckert and Mauchly each signed sworn oaths to that effect on July 19, 1947, and again on September 11, 1963.

13.27 The fact that E directed inquiries to other members of the group or team would indicate that he felt that others had made contributions.

13.27.1 By August, 1945, Eckert and Mauchly informed Army Ordnance patent attorneys that they were the inventors of all inventions arising out of the 1926 contract.

13.27.2 Eckert and Mauchly first designated themselves as co-inventors without the prior consent or knowledge of the University of Pennsylvania.

13.27.3 Ordnance lawyers never questioned this, and never interviewed any other members of the ENIAC team to confirm or alter this representation.

13.27.4 In September, 1944, Eckert, without authority from the Moore School, wrote letters to each Moore School engineer who participated in the ENIAC design asking each man to identify any features of the ENIAC machine to which he claimed inventorship.

13.27.5 Eckert was not authorized by the Moore School or the University of Pennsylvania to write the letters.

13.27.6 Dr. Brainerd reprimanded Eckert for sending the letter and told Eckert that the letter would be interpreted as a request for a waiver of patent rights as a natural act of loyalty to the Moore School in a cooperative spirit.

13.27.7 At least one of the members of the Moore School team, T. Kite Sharpless, notified Eckert that he believed he had made inventive contributions to the design of the ENIAC machine and to the design of the acoustic delay line memory later used in the EDVAC.

13.27.8 Robert F. Shaw also informed Eckert that he claimed inventorship to some features of the ENIAC machine.

13.27.9 In March, 1946, Sharpless wrote Eckert for a second time indicating that Sharpless still believed himself to be a co-inventor to both EDVAC and ENIAC subject matter.

13.27.10 Army Ordnance patent attorneys were not informed about Sharpless and Shaw's claims as co-inventors of the ENIAC; Mauchly told Army Ordnance that there were no such claims, and Libman testified that he relied on this representation in prosecuting the application.

13.27.11 None of the Moore School engineers who were members of the team, other than Eckert and Mauchly, were interviewed by Army Ordnance patent attorneys to determine the actual inventorship of inventions embodied in the ENIAC machine.

13.28 It is unfortunate that Sharpless and Shaw and Burks could not testify.

13.28.1 T. Kite Sharpless and Robert F. Shaw were decreased at the time of trial.

13.28.2 Arthur W. Burks was asked to testify by Honeywell, which offered to pay his reasonable expenses, but Burks would agree to testify only to predetermined issues (as outlined in a written "proffert" filed on his behalf by his attorney); no motion to intervene was filed by Burks and the Court accordingly declined to invite him to testify under the conditions expressed.

13.29 M and E did not falsely claim to be the only inventors.

13.29.1 Honeywell has not proven that there were any inventors or co-inventors, other than Eckert and Mauchly, of the subject matter claimed in the ENIAC patent.

13.29.2 Honeywell has not proven by clear and convincing evidence that Eckert and Mauchly, their attorneys, successors or assigns committed willful and intentional fraud on the Patent Office in connection with any alleged co-inventors of the subject matter claimed in the ENIAC patent.

13.30 The claims anticipated and not anticipated were cited to the Patent Office.

13.30.1 All of the patents relied on by Honeywell as showing anticipation of claims of the ENIAC patent were considered by the Patent Office during the prosecution of the ENIAC patent application.

13.30.2 See 5 and 12 above.

13.31 The First Draft Report, which bars the patent, was referred at one time to the Patent Office and seems to have gotten lost or been misfiled in the Patent Office.

13.31.1 As set out in the Findings under 7 above, it was concluded at the April 8, 1947, meeting, including Eckert, Mauchly and Army Ordnance patent attorneys in attendance, that the von Neumann First Draft Report had been published more than one year prior to the meeting and would bar patents for all material disclosed by the report.

13.31.2 Of the 17 claims of the ENIAC patent at issue in this suit, Honeywell has failed to prove the readability of claims 36, 83, 86, 88, 109, 122 and 142, or any of them, on the First Draft Report.

13.31.3 On May 20, 1947, before the ENIAC patent application was filed, Army Ordnance patent attorney Kessenich sent the Patent Office a copy of the June 30, 1945, von Neumann report; the transmittal did not indicate that the Army Ordnance Patent Section believed it to be a publication, and did not correlate the publication to any specific patent application or to the contemplated ENIAC application; Kessenich noted in his cover letter to the Patent Office only that the report "may be of interest to those examining divisions which are concerned with this subject matter, particularly Div. 23;" however, the transmittal alone was not sufficient to bring the report before any ENIAC examiner; Church anticipated this result when he told Eckert and Mauchly at the April 8, 1947, meeting that a patent examiner might not find the report for years if it was not brought to his attention.

13.31.4. The von Neumann report was never specifically found and cited by any examiners who dealt with the ENIAC application; nor was it ever brought to the attention of those examiners by Eckert and Mauchly or their attorneys at any time during the prosecution of the ENIAC application; the report was not included in the lengthy list of prior art cited by Eckert and Mauchly during the only prosecution on the merits, which commenced with the amendment of May 23, 1963; Manny Pokotilow, the patent examiner who conducted the examination of the ENIAC application under pressure during its 1963 amendment and thereafter to its issuance, testified that he never saw the First Draft Report until it was shown to him in the courtroom; the Court credits the Pokotilow testimony.

13.32 Church and Libman knew, or should have known, that the report was a printed publication which barred the patent.

13.32.1 During 1946, von Neumann submitted a copy of his First Draft Report to the Army Ordnance patent attorneys; Mauchly had been instructed to deliver the report to these attorneys much earlier, but had not done so.

13.32.2 On April 1, 1947, Jules Warshaw of the Moore School staff met with Mauchly and with Kessenich, Church, Libman and Woodward (patent attorneys for Army Ordnance) and told those present about the publication of the First Draft Report: "I pointed out that this report was unclassified and as such had probably had a general distribution such as to make it a publication in the legal sense."

13.32.3 During the subsequent April 8, 1947, meeting, Church and Libman both agreed that the First Draft Report was a printed publication under the patent statute and would be a statutory bar reference against any application filed thereafter; Church stated at the meeting: "It is our firm belief from the facts that we now have that this report of yours dated June 30, 1945, is a publication * * *." and Libman concurred: "That [the report was unclassified] taken together with widespread distribution there seems to be very little doubt about it"; Eckert agreed: "The publication makes what is in the report public property."

13.33 The fact that the Patent Office had the report may excuse the applicants and their counsel.

13.33.1 Although the First Draft Report was forwarded to the Patent Office, there is no evidence that any examiner responsible for the ENIAC application ever knew of the report, and Examiner Pokotilow had no knowledge of it when the patent was granted.

13.33.2 Contrary to Church's advice at the April 8, 1947, meeting, Mauchly stated that inasmuch as he and Eckert did not publish or distribute the First Draft Report, they should try to claim whatever they could.

13.34 There is evidence of lack of good faith and candor on the part of counsel for defendants in attempting to frustrate the efforts of IBM and others to obtain documents relating to ENIAC from the Government.

13.34.1 Information which would have otherwise been available from the Government concerning the ENIAC project was withheld at the urging of counsel for defendants from IBM when that company was attempting to institute public use proceedings against the ENIAC patent application. Attorneys for Remington Rand (later SR) served as co-counsel with attorneys for the Ordnance Department, together representing Eckert and Mauchly in Patent Office proceedings, from at least June 20, 1950, onward.

13.34.2 On October 14, 1955, IBM attorney Charles P. Boberg wrote a letter asking that Army Ordnance verify that OCM 29904 declassified the general design principles and the operational and functional characteristics of the ENIAC.

13.34.3 On November 1, 1955, Army Ordnance attorney Thibodeau wrote to Boberg and stated that "your information regarding the OCM item referred to in your letter is incorrect"; Thibodeau said that it was OCM 31419, dated February 13, 1947, that declassified the ENIAC general principles of design and operational and functional characteristics.

13.34.4 On June 1, 1956, IBM filed a petition for the institution of public use proceedings against the ENIAC application in the U.S. Patent Office; until such public proceedings use should be allowed (which never occurred), IBM had no right to employ any discovery procedures such as are provided in the Federal Rules of Civil Procedure.

13.34.5 On July 18, 1956, the Patent Office dismissed IBM's petition for the institution of public use proceedings filed on June 1, 1956, as premature but without prejudice to a subsequent timely renewal following termination of the pending interference No. 46,576.

13.34.6 On December 19, 1955, IBM asked the Government for copies of contract W–670–ORD–4926, including all supplementary and amendatory papers and any papers evidencing a formal acceptance of the ENIAC by the Government or a transfer of title to the Government.

13.34.7 The 4926 contract (with supplements) established that title to the ENIAC passed to the Government at the time the machine was completed, that the time for delivery of the ENIAC was never extended beyond December 31, 1945, and that no work on ENIAC was required to be done under the 4926 contract after December 31, 1945.

13.34.8 On January 18, 1956, Boberg stated in a memorandum that IBM needed a copy of the ENIAC contract in order to determine whether or not there was a sale of the ENIAC in the statutory sense more than one year prior to the ENIAC application filing date.

13.34.9 On February 17, 1956, Thibodeau of Ordnance notified IBM that its request for the contract had been considered, but that, in accordance with Army regulations, it was not available for the purpose of assisting IBM in Patent Office proceedings.

13.34.10 On February 2, 1956, IBM requested that Ordnance supply a certified copy of OCM item 29904, dated December 20, 1945.

13.34.11 On February 7, 1956, IBM sent a telegraphic message to Army Ordnance, asking that its February 2, 1956, letter be answered, whereupon Thibodeau informed IBM by telephone that its request for OCM item 29904 was denied.

13.34.12 On February 20, 1956, IBM again wrote Ordnance, stating that in lieu of item 29904, IBM was willing to accept from Ordnance a statement that, effective 20 December 1945, the general principles of design and the operational and functional characteristics of the ENIAC equipment were unclassified under the authority of OCM item 29904.

13.34.13 On February 28, 1956, a conference was held between Thibodeau and McGee (of Ordnance), and Boberg and Hogan (attorneys for IBM), in which it was pointed out by IBM that, if a dedication to the public of the inventions claimed in the ENIAC application because of public use could be shown, the claims being contested in the IBM-Sperry Rand interferences would fall into the public domain.

13.34.14 On February 20, 1959, IBM, still without the benefit of formal discovery procedures or access to documents filed in other interferences, filed a renewal of its petition for the institution of public use proceedings in the Patent Office.

13.34.15 On June 4, 1959, First Assistant Commissioner Crocker of the Patent Office directed the primary examiner of Division 23 to make a report, following investigation, of whether the documents submitted with the renewal petition made a prima facie showing of public use of the ENIAC prior to the critical date.

13.34.16 On October 27, 1959, SR attorney Hall notified Army Ordnance that he had retained Thibodeau (the ex-government attorney who had been respon-

sible for denying IBM access to Government documents), and Hall told Army Ordnance that Thibodeau would help SR secure information from Army Ordnance to help SR win any or all ENIAC interferences and public use proceedings connected therewith.

13.34.17 Remington Rand (later SR) had previously retained Libman (at least as early as September 22, 1952) he having been the Army Ordnance attorney who prepared and filed the ENIAC application as attorneys for Eckert and Mauchly.

13.34.18 On October 30, 1959, attorney Rotondi of Army Ordnance recommended that Thibodeau, as well as Hall, be permitted free access to all the unclassified Army Ordnance files pertinent to the ENIAC interference and public use proceedings.

13.34.19 On November 2, 1959, Hall prepared an affidavit for signing by George E. Stetson of Army Ordnance for use in the public use proceedings, in which Stetson swore that the absence of documentation on use of the ENIAC machine was of negative significance to any contention of public use because the use of ENIAC by non-Ordnance Department personnel would have been accompanied by communications between such parties and Army Ordnance and by other documentation, all of which would be matters of record in the Ordnance Department if such had ever occurred.

13.34.20 The November 2, 1959, SR memorandum in opposition to the IBM renewed public use petition also stated that SR had filed certified copies of actual orders issued by the Army setting forth the military classification of the ENIAC project throughout the entire period in question, even though SR had never filed OCM 29904, and a copy of it had been denied to IBM by Army Ordnance.

13.34.21 On November 5, 1959, A. C. Lazure, an Army Ordnance attorney, stated that SR should be given whatever assistance is available in the files of Ordnance, but that IBM's request for information should continue to be denied.

13.34.22 On November 6, 1959, McGee of Ordnance informed Ostmann, IBM's Washington counsel, by telephone that its request for certified document copies was denied.

13.34.23 On November 12, 1959, Hall recorded in writing his previous advice to Army Ordnance as to why it should not assist IBM in the Patent Office public use proceeding involving the ENIAC, but rather should assist and make available Government documents only to SR to assure that the ENIAC patent application remained pending and ultimately issued into a patent.

13.34.24 On December 14, 1959, Hall filed a reply memorandum in opposition to the IBM renewed public use petition, pointing out that IBM had been unable to refer to (1) a single leak in the Government's security order, (2) the name of a single person, not under injunction to secrecy, who either received, or had available to him, any information about any novel circuit of the ENIAC, (3) a single practical problem that was put to the machine because someone wanted to know the answer to it, (4) a single answer that was checked and found correct, (5) a single instance in which anybody connected with the project attempted to make a single penny profit from any alleged use of the machine, (6) a single mention of any particular part of the ENIAC, allegedly involved in the demonstration, (7) a single allegation, other than hearsay, implying that the machine was beyond the test stage, (8) a single document, indeed not even anything as big as a postage stamp, showing the structure alleged to be in public use.

13.34.25 On May 16, 1960, First Commissioner Crocker of the Patent Office denied IBM's renewal petition to institute public use proceedings.

13.35 Apparently, eventually some or all of the documents were obtained.

13.36 No effort was made, however, by counsel for defendants to obtain information from the AEC when that agency offered to provide additional information.

13.36.1 The existence of documents and potential testimony concerning the Los Alamos calculations was not revealed to BTL or the District Court for the Southern District of New York.

13.36.2 The ENIAC machine was used between December 10, 1945 to mid-March, 1946, to calculate the solutions to numerical equations relating to studies of the feasibility of hydrogen bomb designs being considered by the Los Alamos Laboratory.

13.36.3 On November 5, 1954, in BTL interference 85,809, SR, in an effort to establish an early reduction-to-practice, represented to the Patent Office:

.1 that the first real problem to be put on the ENIAC was one originating in the Los Alamos scientific laboratories under the atomic energy project;

.2 that the problem took approximately one month, of which two weeks were actual running time;

.3 that, at the time, the ENIAC machine was a complete and operable calculating instrument;

.4 that there were no difficulties with the machine, but rather any difficulties were with the mathematical nature of the Los Alamos problem, and mistakes of the mathematicians;

.5 that there were no long periods of maintenance or repair shutdown; and

.6 that the general practice was to operate on a continuous basis.

13.36.4 On December 1, 1961, Carroll G. Harper, an associate in the patent law firm of Byerly, Townsend, Watson & Churchill of New York City, which had been retained by SR as counsel for the litigation with BTL, wrote the Atomic Energy Commission, asking for information concerning the Los Alamos problem.

13.36.5 Harper's inquiry of December 1, 1961, was directed to Roland Anderson, Assistant General Counsel for Patents, United States Atomic Energy Commission, Germantown, Maryland.

13.36.6 In his December 1, 1961, letter to Anderson, Harper pointed out that BTL and SR had agreed that evidence would be submitted to the U.S. District Court for the Southern District of New York largely upon affidavits, depositions and exhibits, all of which were to be submitted and marked in evidence in court on January 19, 1962.

13.36.7 In his December 1, 1961, letter to Anderson, Harper asked the A.E.C. to confirm SR's position that the Los Alamos problem was simply an initial, extremely simplified problem, the results of which could not have been put to any practical use nor could have formed the basis for any design or construction of an actual device, and the results, in any event, lay dormant in the Government files for a number of years.

13.36.8 On December 1, 1961, SR knew of the existence of an official Los Alamos classified report, designated report number LA–525, issued March 2, 1950, and entitled "Ignition of Deuterium-Tritium Mixtures, Numerical Calculations Using the ENIAC," the number, date and title of which were not classified and asked the A.E.C. if it could be declassified.

13.36.9 In addition to writing Anderson on December 1, 1961, Harper also discussed the substance of his request with Anderson by telephone on the same day.

13.36.10 On December 5, 1961, Harper again wrote Anderson, pointing out that, if report number LA–525 could not be declassified, SR desired to obtain an affidavit from at least one person in an official position at Los Alamos concerning the nature of the relevant ENIAC calculations and what was done with the results to the extent that secrecy restrictions would permit.

13.36.11 At the request of Anderson, Strausser of the A.E.C. office of classification reviewed report number LA–525 and confirmed that it was not declassifiable in its entirely; at trial it was established that its substance could have been procured on revelant points.

13.36.12 At the request of Anderson, William B. Holton, of the A.E.C. headquarters technical staff in Maryland, with Strausser, studied classified reports describing the Los Alamos problem, and each of them concluded:

.1 that the problem worked on the ENIAC machine by Los Alamos personnel beginning about December, 1945, was not trivial or a mere test problem;

.2 that it was a substantial problem which was successfully and satisfactorily solved;

.3 that the results were useful; and

.4 that the results did not lie dormant.

13.36.13 On December 8, 1961, Holton delivered a handwritten memorandum to Anderson describing the nature of the Los Alamos problem, and observing that the facts regarding that problem were directly contrary to the view SR hoped to establish.

13.36.14 On December 13, 1961, Anderson wrote to Harper informing him of the A.E.C.'s position that the Los Alamos work on the ENIAC machine was a substantial effort which successfully and satisfactorily solved specific problems and that the results were useful and did not lie dormant, and offered to establish this position by affidavit.

13.36.15 On the same day, December 13, 1961, Anderson also wrote to Mr. Henry Heyman, Los Alamos Scientific Laboratory, Los Alamos, New Mexico, asking Heyman to ascertain whether or not there was someone at Los Alamos who could make an affidavit as to the work and extent of use of the ENIAC machine on the Los Alamos problem.

13.36.16 On December 18, 1961, Anderson discussed with Harper by telephone the possibility of submitting affidavit evidence concerning the Los Alamos problem; Harper informed Anderson that, based on the information contained in Anderson's letter of December 13, 1961, SR considered that an affidavit "might not be too helpful".

13.36.17 On December 18, 1961, in his telephone conversation with Anderson, Harper stated that SR and BTL were going to exchange proofs on the following day, although in his December 1, 1961, letter to Anderson, Harper had stated that affidavits were to be submitted in evidence to the court on January 19, 1962.

13.36.18 Meanwhile, at the Los Alamos Scientific Laboratory in New Mexico, in response to Anderson's request of December 13, 1961, Heyman discussed the Los Alamos problem with Dr. Carson Mark in order to obtain the requested information.

13.36.19 On or about January 4, 1962, Mark informed Heyman that the problem run on the ENIAC machine related to the Super (the hydrogen bomb) and was run in the latter part of 1945 and early part of 1946.

13.36.20 On or about January 4, 1962, Mark also informed Heyman that the Los Alamos problem was of scientific investigative nature and was by no means a simple one, and that the ENIAC machine correctly handled the mathematical processes based upon the information coded into the machine.

13.36.21 Harper's letters of December 1, 1961, and December 5, 1961, as well as Anderson's response of December 13, 1961, have been in the possession of defendant's counsel, John P. Dority, since 1963.

13.36.22 On June 13, 1968, Honeywell served interrogatories on SR in this action, seeking the identification and ultimate production of all materials in defendant's possession which involved the operation of the ENIAC machine during the time period July 1, 1944 through August 25, 1946, and which were not introduced into evidence in any interference or public use proceeding or in the litigation between SR and BTL.

13.36.23 The Harper-Anderson correspondence was not identified in SR's answers to Honeywell's interrogatories and was not produced for Honeywell until after SR had been given notice, in April, 1970, that Honeywell intended to take the deposition of the custodian of documents at Los Alamos.

13.36.24 On October 16, 1970, Honeywell brought a motion in this action to abrogate SR's claim of privilege as to all materials relating to the Los Alamos problem, this motion having been based in part upon Honeywell's external discovery of the existence of the correspondence between Harper and Anderson which had never previously been produced or identified for either BTL or Honeywell.

13.36.25. Honeywell's motion to abrogate the claim of privilege with respect to the Los Alamos problem documents was set for hearing on November 23, 1970.

13.36.26 On November 13, 1970, SR attorney Hall in Washington, D.C. telephoned Anderson to inquire concerning Anderson's December 13, 1961, letter to Harper; Hall was informed by Anderson that the A.E.C. had in its possession the letter by Heyman dated January 4, 1962, and that the letter was available to him upon written request.

13.36.27 SR did not produce or report its knowledge of the Heyman letter of January 4, 1962, at the November 23, 1970, hearing held before this Court on Honeywell's motion to abrogate the claim of privilege with respect to Los Alamos documents.

13.36.28 The Heyman letter of January 4, 1962, was first made known to Honeywell by SR when it was ultimately produced for the court on December 18, 1970, with the explanation that SR did not have the letter until subsequent to the argument on November 23, 1970.

13.37 Counsel for defendants chose instead to confine the investigation to Metropolis and Frankel.

13.37.1 The Los Alamos Laboratory personnel who performed the calculations with the ENIAC machine at the Moore School, and reported their results to Teller and others, were Dr. Nicholas Metropolis and Dr. Stanley Frankel.

13.37.2 On or about October 29, 1959, Libman, then in private practice, prepared an affidavit for the signature of Metropolis for use in opposition to the IBM public use petition, wherein Metropolis was to swear that, although he (Metropolis) had a complex problem, he knew it could not be solved on the ENIAC machine and that he visited the Moore School only in the hope of obtaining information about the potentialities of an electronic digital computer.

13.37.3 Metropolis refused to sign the October, 1949 affidavit prepared by Libman, but on November 2, 1959, Metropolis did sign a revised affidavit which had been prepared by SR and which was thereafter filed in the Patent Office.

13.37.4 The revised, November 2, 1959, Metropolis affidavit differed materially from the earlier draft, omitting any reference to the complex problem, except what could be deduced from the newly formulated statement that Metropolis learned about some of the preliminary qualitative features of the physical problems the calculational form of which represented a considerable simplification.

13.37.5 An affidavit purporting to describe the Los Alamos problem was obtained from Metropolis on January 31, 1962, and filed with the court in the SR v. BTL case.

13.37.6 An affidavit of Frankel was obtained on February 6, 1962, which also purported to describe the Los Alamos problem.

13.37.7 Such affidavits did not state sufficient facts to prevent their conclusory content from being misleading as now appears from the record in this case.

13.38 They may have thus withheld information from the Patent Office and the District Court.

13.38.1 The District Court for the Southern District of New York, based on the limited evidence presented, found that the work done by the ENIAC machine on the Los Alamos problem was highly classified, and (erroneously) that the only two persons who knew the nature of the problem were Metropolis and Frankel, who submitted affidavits that the results were not checked for accuracy, that there were almost certainly some undetected errors.

13.38.2 Because no effort was made to obtain information from the A.E.C., and information may thus have been withheld, all of the essential facts presented at this trial concerning the Los Alamos problem, had not been placed before Judge Dawson through the limited affidavits and/or deposition testimony of witnesses.

13.38.3 The New York District Court's findings was thus directly contrary to the clear and convincing evidence presented in this action which establishes that the Los Alamos work on ENIAC was in fact a substantial effort which successfully and satisfactorily solved specific problems and that the results were useful and did not lie dormant.

13.39 The Court finds and concludes that despite the various derelictions of M and E, defendants and their counsel that the claim of willful and intentional fraud on the Patent Office has not been proved by clear and convincing evidence.

13.39.1 Honeywell has not proven by clear and convincing evidence any willful and intentional fraud on the Patent Office concerning the ENIAC patent.

13.39.2 Honeywell has not proven that defendants or their predecessors violated the Sherman Act in the filing and prosecution of the ENIAC patent application and/or in the enforcement of the ENIAC patent.

13.39.3 Honeywell has not proven by clear and convincing evidence that Eckert and Mauchly, their attorneys, successors or assigns, committed willful and intentional fraud on the Patent Office in connection with the public use of the claimed subject matter of the ENIAC patent.

13.39.4 Honeywell has not proven by clear and convincing evidence that Eckert and Mauchly, their attorneys, sucessors or assigns, committed willful and intentional fraud on the Patent Office in connection with the Los Alamos problem.

13.39.5 Honeywell has not proven by clear and convincing evidence that Eckert and Mauchly, their attorneys, successors or assigns, committed willful and intentional fraud on the Patent Office in connection with the February, 1946, demonstration and dedication.

13.39.6 Honeywell has not proven by clear and convincing evidence that Eckert and Mauchly, their attorneys, successors or assigns, committed willful and intentional fraud on the Patent Office in connection with Hartree's use of the ENIAC machine.

13.39.7 All of the essential facts presented at this trial concerning the investigation of alleged public use by the attorneys responsible for filing the ENIAC patent application were not placed before Judge Dawson through the deposition testimony of Max L. Libman.

13.39.8 Honeywell has not proven by clear and convincing evidence that Eckert and Mauchly, their attorneys, successors or assigns, committed willful and intentional fraud on the Patent Office in connection with the alleged "on sale" condition of the inventive subject matter claimed in the ENIAC patent.

13.39.9 Honeywell has not proven by clear and convincing evidence that Eckert

and Mauchly, their attorneys, successors or assigns, committed willful and intentional fraud on the Patent Office in connection with the work of Atanasoff.

13.39.10 Honeywell has not proven by clear and convincing evidence that Eckert and Mauchly, their attorneys, successors or assigns, committed willful and intentional fraud on the Patent Office in connection with alleged anticipation by prior art patents.

13.39.11 Honeywell has not proven by clear and convincing evidence that Eckert and Mauchly, their attorneys, successors or assigns, committed willful and intentional fraud on the Patent Office in connection with the RCA Reports, the AMP Report and/or the Burks Article.

13.39.12 Honeywell has not proven by clear and convincing evidence that Eckert and Mauchly, their attorneys, successors or assigns, committed willful and intentional fraud on the Patent Office in connection with the First Draft Report.

13.39.13. Apart from attorney's fees, Honeywell has not proven that it suffered any injury to its business or property by reason of the existence of the ENIAC patent.

13.39.14 Honeywell has not proven that defendants or their predecessors violated the Sherman Act in the filing and prosecution of the ENIAC patent application and/or in the enforcement of the ENIAC patent against Honeywell.

[46] 13.39.15 To recover antitrust damages based on alleged fraud in obtaining a patent, the plaintiff must prove (1) willful and intentional fraud, (2) injury to business or property caused by the fraudulently procured patent, and (3) the other elements necessary to a Section 2 Sherman Act violation.

13.39.16 Good faith or an honest mistake is a complete defense to an antitrust action based on fraud on the Patent Office.

13.39.17 To prove an antitrust violation based on fraud on the Patent Office, the proof of fraud must be by clear, unequivocal and convincing evidence; a mere preponderance of the evidence is not enough.

13.39.18 "The road to the Patent Office is so tortuous and patent litigation is usually so complex, that 'knowing and willful fraud' as the term is used in Walker, can mean no less than clear, convincing proof of intentional fraud involving affirmative dishonesty, 'a deliberately planned and carefully executed scheme to defraud * * *.' "

13.39.19 "A person attacking the validity of a patent for alleged fraudulent representations must prove that the representations were material—that the patent would not have issued but for the representations."

13.39.20 An applicant for a patent need not set up "straw men which he reasonably and in good faith believes he can knock down."

13.39.21 The requirement of "full, frank disclosure * * * does not mean an applicant must list out the full spectrum of his knowledge to establish bona fides."

14. 25 Other Patents and Patent Applications

14.1 These are the so-called 30A patents and patent applications.

14.1.1 Honeywell amended its Amended Complaint (by Order of Court entered September 19, 1969) to add paragraph 30A, alleging that SR claimed to own or control a "Patent Portfolio" containing issued patents and pending patent applications that are subject to the same types of infirmities as he ENIAC patent, and that the procurement, licensing and attempted enforcement by SR of these additional patents and applications constituted a further part of the originally alleged fraudulent and conspiratorial pattern of conduct by SR in restraint of trade.

14.1.2 Honeywell contends that these applications and patents (hereinafter the 30A patents and applications") evidence a pattern of conduct calculated to procure and maintain a patent portfolio of dominance over the computer industry, and that the 30A patents and applications have been and are being procured in disregard of the uncompromising duty of fairness and full disclosure to the Patent Office and the courts in patent matters.

14.1.3 During the discovery stake of this lawsuit, SR produced for Honeywell's inspection and copying hundreds of SR patent application files.

14.2 Several have been abandoned, several have expired, and two—BINAC and UNIVAC—are still pending.

14.2.1 Honeywell has offered evidence with respect to twenty-five 30A patents and applications to establish SR's pattern of prosecuting applications and procuring patents known to be barred by printed publications, public uses, sales, or other invalidating infirmities.

14.2.1.1 In addition to its charges concerning the ENIAC patent, Honeywell has charged fraud on the Patent Office in connection with two pending patent applications, two abandoned patent applications, and 19 patents (ten of which have expired).

14.2.2 These other patents and patent applications within SR's EDP portfolio are as follows:

EM No.	Patent No. or application No. if no patent has issued	Filing date	Name	Issue date or condition if no patent has issued
1	2,629,827	Oct. 31, 1947	Regenerative memory	Feb. 24, 1953
8	2,969,478	June 10, 1949	Electrostatic storage memory	Jan. 24, 1961
14	2,687,473	Apr. 13, 1950	Cycling unit	Aug. 24, 1954
19	2,708,554	July 29, 1950	Uniservo tape unit	May 17, 1955
19a	3,189,290	do	do	June 15, 1965
19b	2,901,734	do	do	Aug. 25, 1959
20	2,686,299	June 24, 1950	BINAC function table	Aug. 19, 1954
21	2,600,744	Oct. 21, 1950	Serial binary adder	June 17, 1952
22	SN 179,782	Aug. 16, 1950	BINAC system	(1)
23	2,646,501	Oct. 21, 1950	Unit adder	July 21, 1953
25	2,673,293	do	Serial binary full adder	Mar. 23, 1954
26	2,655,598	do	Parallel binary adder	Oct. 13, 1953
27	SN 194,112	Nov. 4, 1950	Excess-3 binary coded decimal adder	(2)
28	SN 213,072	Feb. 28, 1951	Parallel excess-3 binary coded decimal adder	(2)
29	2,590,950	Nov. 16, 1950	Function table full adder	Apr. 1, 1952
39	SN 279,710	Mar. 31, 1952	UNIVAC system	(1)
40	2,860,756	do	Uniprinter	Nov. 18, 1958
41	2,860,325	do	Unityper	Nov. 11, 1958
42	3,133,190	do	UNIVAC arithmetic unit	May 12, 1964
43	2,781,446	Mar. 28, 1952	UNIVAC cycling unit	Feb. 12, 1957
44	3,056,947	Mar. 31, 1952	Card to tape unit	Oct. 2, 1962
48	2,748,270	do	UNIVAC clock gate and pulse former	May 29, 1956
	2,842,663	June 10, 1955	Binary signal comparator	July 8, 1958
	2,915,966	June 13, 1955	High speed printer	Dec. 8, 1959
	2,938,193	June 10, 1955	Binary signal encoder	May 4, 1960

[1] Still pending.
[2] Abandoned.

14.3 Plantiff has not been directly charged with infringement of any of the issued patents.

14.3.1 SR has raised no counterclaim in this case charging Honeywell with infringement of any patents, but ISD has raised a counterclaim for infringement of the ENIAC patent.

14.3.2 SR and ISD have represented to this Court that no charge of infringement has been directed against Honeywell under any patents other than the ENIAC patent.

14.4 Plaintiff claims, however, that these patents and patent applications were referred to as part of defendants' portfolio in the negotiations which preceded this lawsuit.

14.4.1 When Honeywell and other competitors within the EDP industry raised their own patents against SR as trading material to offset ISD's charges of infringement of the ENIAC patent, SR responded by correspondingly raising other patents and pending applications, including its 30A patents and applications, for bargaining purposes in the negotiation of any possible overall cross-license settlement of the ENIAC patent controversy.

14.4.2 For example, ISD had sought a one and one-half percent royalty from National Cash Register Co. (NCR) for license rights under the ENIAC patent; and in the negotiation for a possible overall cross-license between NCR and SR, including the ENIAC patent being asserted by ISD, SR contended that all equal exchange was inappropriate because additional royalties should be accorded to the weight of its EDP patent portfolio including its 30A patents and applications, over NCR's portfolio.

14.4.3 SR had called over 1000 of its patents to the attention of GE, including the ENIAC patent and its 30A patents and applications, and sought royalties of 8.5 million dollars; SR internally registered doubt as to the enforceability of the ENIAC patent, and estimated that the "Chance of winning in court is less than 50%."

14.4.4 When a one and one-half percent royalty was sought from RCA under the ENIAC patent, SR contended that the rest of its EDP portfolio, including its 30A patents and applications, had "a greater value than the ENIAC patent."

14.4.5 SR and ISD had contended in their negotiations with RCA that SR's portfolio of other patents, including the 30A patents and such 30A applications as BINAC and UNIVAC I, gave SR the "basic position in the systems area."

14.4.6 During negotiations with Honeywell, SR discussed ten patents from its EDP portfolio, including the EM–1 regenerative memory in '827 patent and the high-speed printer or '966 patent among the 30A group; the fact of the pendency of SR's UNIVAC application, within the 30A group, was also considered, SR contended that its patent portfolio, exclusive of ENIAC but including the 30A patents and applications, was at least as valuable as the entirety of Honeywell's EDP patent rights.

14.5 Plaintiff claims also that they were used as leverage in obtaining the IBM and BTL license agreements.

14.5.1 On August 21, 1956, IBM and Sperry Rand entered into an agreement including:

1. a cross-license under all of their respective EDP and tabulating (TAB) equipment patents and patent applications, including the ENIAC application and the 30A patents and applications;

2. a settlement of all EDP and TAB Patent Office interferences; and

3. an exchange of secret and proprietary EDP and TAB equipment know-how.

14.5.2 BTL and Western Electric entered into a cross-license with SR dated July 1, 1961.

14.6 Plaintiff claims that the fraudulent procurement of the portfolio was part of an overall scheme to monopolize and restrain trade.

14.7 The emphasis in plaintiff's claim of infirmities is on public use and on sale.

14.8 Other claims rest on derivation from Atanasoff, incomplete application at time of execution, and omission of co-inventors.

14.9 As to publication, plaintiff relies on the First Draft Report (already found to be a printed publication before the critical date) [Findings 7.1–7.1.6 above], the EDVAC report of September 30, 1945, the EDVAC report of June 30, 1946, three lectures of the Moore School lecture series, and the report on the UNIVAC.

[47] 14.10 I find that as part of an action in antitrust that plaintiff has standing to assert these claims, that no claims of infringement have been made by defendants on the issued patents, and that defendants have made no demands for royalties on the applications.

14.11 I find that the publications referred to above (In Finding 14.9) were printed publications before the critical dates, that the claims as to public use and on sale before the critical dates have been proved, that the claims as to derivation from Atanasoff as to EM–1 have been proved, that the claims as to incomplete execution have been proved, and that the claim as to the omission of a certain inventor has been proved.

14.11.1 Publications.

The June 30, 1946 EDVAC Report

14.11.1.1 The Progress Report on the EDVAC, dated June 30, 1946, (hereafter called the EDVAC Report) became a printed publication more than one year prior to June 10, 1949, the filing date of the EM-8 application .

14.11.1.2 The Court notes that in prior litigation, SR swore in answer to an interrogatory that the publication date of the EDVAC Report was June 30, 1946.

14.11.1.3 The EDVAC Report was completely declassified on or before February 13, 1947.

14.11.1.4 During the spring of 1947, persons skilled in the computer art were notified about the declassification of the EDVAC Report.

14.11.1.5 The declassification of EDVAC information, such as the EDVAC Report, was widely publicized during March of 1947, including press reports in the New York Times, Philadelphia Bulletin and Philadelphia Inquirer.

14.11.1.6 By the spring of 1947, Eckert and Mauchly were aware of the declassification of the EDVAC Report.

14.11.1.7 By March 1948, the EDVAC Report had been widely distributed and was available to all persons having an interest in the computing arts, as a result of its unrestricted classification, its availability to persons attending the 1946 Moore School Lecture Series and its availability in the Library of Congress.

14.11.1.8 By the end of June, 1948, copies of the EDVAC Report were available in the Moore School Library and were being loaned by that library to other institutions, including Johns Hopkins University; a review of the EDVAC Report was published in the January 1949 edition of Mathematical Tables and Others Aids to Computation, and Eckert cited the EDVAC Report in an article (which he coauthored) published in the August 1949 edition of the Proceedings of the I.R.E.

14.11.1.9 In 1957, SR's patent agent, English, who was assigned to an EM–8 interference, withheld the existence of the EDVAC Report from the Patent Office "since it might be used as an anticipating publication against our application EM–8."

14.11.1.10 The stated purpose of the EDVAC Report was to serve as a disclosure to the Patent Office of possibly patentable ideas, and Eckert, Mauchly and defendants" predecessors and lawyers used the EDVAC Report to this end; in October 1946, Eckert and Mauchly asked for and received permission to inspect the EDVAC Report for the purpose of preparing patent applications; the following applications or patents were derived from portions of the EDVAC Report by Mr. Eltgroth, a patent attorney for Eckert-Mauchly Computer Corporation team (EMCC) and Remington-Rand (RR), both predecessors of SR: EM–21, 23, 25, 26, 27, 28 and 29; two attorneys, Messrs. Eltgroth and Light, handled the prosecution of each of these patent applications; examples of the correspondence of the EDVAC Report with the applications or patents are hereinafter found and set forth.

14.11.1.11 Figure 1 of the EM–21 patent has a one-for-one relationship in all significant respects to EDVAC Report drawing PY–0–105, described at pages 1–1–2 through 1–1–5 of the EDVAC Report; Figure 1 of the EM–23 patent shows the same circuit, except for immaterial variations, as that shown and described in EDVAC Report drawing PY–0–105 and pp. 1–1–2 through 1–1–5; Figures 5, 6 and 7 of the EM–25 patent show the same circuits as are shown and described in EDVAC Report drawings PY–0–177, PY–0–178 and PY–0–174 and at pp. 1–1–11 through 1–1–13; Figure 2 of the EM–26 patent shows the same circuit as that shown and described in EDVAC Report drawing PY–0–177 and page 1–111 of the EDVAC Report.

14.11.1.12 During August, 1952, the patent examiner assigned to the EM–27 application located the EDVAC Report unaided by defendants or their attorneys and found that: "This reference [the EDVAC Report] discloses a circuit which is manifestly identical in all respects to the instant alleged invention"; the Court concurs with the examiner's finding; Figure 1 of the EM–27 application shows the same circuit as that shown and described in Report drawing PY–0–108 and pages 1–1–27 through 1–1–29 of the EDVAC Report; RR's attorney prosecuting EM–27, E. J. Light, also concurred, stating that the EDVAC Report was "a publication identical to the disclosure" of EM–27.

14.11.1.13 Figure 1 of the EM–28 application illustrates the same circuit shown and described in EDVAC Report drawing PY–0–181 and pages 1–1–29 through 1–1–30 of the EDVAC Report.

14.11.1.14 Figures 1 and 2 of the EM–29 case were based upon drawings PY–0–101 and PY–0–102 of the EDVAC Report; when the EM–29 application was drawn into an interference (No. 85,958), RR's patent attorney, Light, reported to Eckert and Mauchly that the adder described in the EM–29 patent was described in the EDVAC Report.

14.11.1.15 Yet RR's attorneys failed to state to the Patent Office at any time during the EM–29 prosecution and interference that the EM–27 examiner had found the EDVAC Report to be a printed publication more than one year prior to the EM–29 filing date.

The Moore School Lecture Series

14.11.1.16 During July and August of 1946, a lecture series was held at the Moore School entitled "Theory and Techniques for Design of Electronic Digital Computers."

14.11.1.17 The lectures were recorded and edited by the respective lecturers for publication, and were published in four volumes between September 19. 1947 and June 30, 1948.

14.11.1.18 These published lectures (hereafter called the "Lecture Series") were made available in the Moore School Library, and Lectures 1 through 48 in fact were checked out by borrowers prior to October 17, 1949; this same

Lecture Series was also made available at the Library of Congress on or before November 12, 1948.

14.11.1.19 The following applications or patents were based substantially on portions of the Lecture Series, published before the earliest critical date of the applications or patents: EM–21, 25 and 26, all filed on October 21, 1950; and EM–28, filed February 28, 1951.

.1 Figure 1 of EM–21 shows the same circuit as that shown and described by Eckert in Lecture 23.

.2 Figure 5 of the EM–25 case is also known and described by Eckert in Lecture No. 23.

.3 Figure 1 of the EM–26 case is derived from Figure 6 of Lecture No. 46, and Figure 2 of EM–26 shows the same circuit shown and described in Lecture 23.

.4 The alleged invention of EM–28 is shown and described in Lecture No. 46; this is the case in which the examiner found the published Lecture and rejected the application, stating: "Claims 1–7 are rejected as fully met by the Moore School Publication"; RR did not contest the rejection, but instead abandoned the case.

14.11.1.20 By summer of 1949, more than one year before Eckert and Mauchly filed EM–21, 25, 26 or 28, they both were aware that the published Lecture Series was publicly available; Mauchly observed as much to his attorney Eltgroth, writing, on May 2, 1949, that as a result of the published review of the Lecture Series "a larger segment of the public will now be aware of their existence. I believe that these lectures should be on file in the patent department"; Mauchly also noted in the same communication that the publication announced the "availability of the lecture course" and "that these lectures are now available at $5.00 per volume as long as the supply holds out."

14.11.1.21 Of the EM–21, 25, 26 and 28 applications, only EM–28 failed to issue because the EM–28 examiner found the published Lecture Series on his own initiative and rejected the application "as fully met by the Moore School Publication [Lecture No. 46] cited above"; however, the examiners of the EM–21, 25 and 26 applications (all of which ultimately issued as patents) failed to find the published Lecture Series, and defendants' predecessors' attorneys, Eltgroth and Light, did not inform those examiners about the Lecture Series or the rejection of the EM–28 application thereon.

The First Draft Report

14.11.1.22 In addition to the barring of the valid issuance of the ENIAC patent, the publication of the von Neumann First Draft Report also anticipates the claims of the EM–1 patent No. 2,629,827 entitled "Regenerative Memory."

The Report on the UNIVAC

14.11.1.23 During the fall of 1947, Eckert and Mauchly submitted under contract to the Bureau of Standards a Report on the UNIVAC. This report discussed all phases of a proposed UNIVAC computer and included many detailed schematic diagrams of circuits to be employed in the UNIVAC computer.

14.11.1.24 In 1947 and 1948, copies of the Report on the UNIVAC were widely distributed and effectively "published" with the knowledge and consent of high-ranking officers of SR's predecessor, the Eckert-Mauchly Computer Corporation (EMCC); the distribution included: making the report available to the Prudential Insurance Company; circulating the Report, according to Mauchly, "rather widely through governmental agencies"; and making the Report available at the library at Harvard University.

14.11.1.25 An employee of EMCC, Isaac Auerbach, assessed the widespread distribution of the Report in an April 8, 1948 memo, stating with respect to a suggestion to limit its further reproduction: "What a laugh at this late date! * * * Our report has already received widespread circulation."

14.11.1.26 During April 1948, EMCC requested an opinion from its patent attorneys, Busser and Harding, about the steps which it might take to call in copies of the Report on the UNIVAC which the Bureau of Standards had already published.

14.11.1.27 With regard to the testimony of McPherson (a disinterested non-party witness) and Mauchly relating to Mauchly's statement to McPherson that the Report on the UNIVAC was studied at the Harvard University Library, the Court finds McPherson credible.

14.11.1.28 SR and ISD admit that the Report on the UNIVAC was made available to Prudential; on October 12, 1948, EMCC was informed by Cannon of the Bureau of Standards that the Report on the UNIVAC shall be "available to all governmental agencies requesting it, unless you [EMCC] can furnish us with a sound reason for refusing the request"; EMCC replied that it had no such objection; on July 8, 1949, attorney Eltgroth informed Mauchly that the Report "will be available on a reciprocal basis to parties having a legitimate interest therein."

14.11.1.29 Many patent applications describing the UNIVAC computer were filed by RR. These applications are anticipated by the Report on the UNIVAC which provided a detailed description of the same UNIVAC computer. These applications include EM–14 (filed April 13, 1950), and EM–30 through 44 and 48 (all filed March 31, 1952, except EM–43, filed March 28, 1952).

14.11.1.30 RR's patent attorney, Eltgroth, admitted that the computer described in the EM–22 application is disclosed in the Report on the UNIVAC, stating that "the computer described in that application [EM–22] is operable and embodies all the essential material of the study report"; Eltgroth earlier indicated that "applications have been filed or are now being filed for a considerable portion of the inventive material disclosed in these reports * * * "; while Eltgroth went on to conclude that the reports had not been published, the Court finds that this was not correct.

14.11.1.31 SR admits that the EM–20 application purported to cover the encoding and decoding function tables used with the BINAC system shipped to Northrop during 1949; in order to prove prior inventorship, Eckert filed an affidavit claiming such an invention prior to May 6, 1948, and supported the affidavit with drawing D69–1077 entitled "Tank Selector Circuit of Memory Switch"; this drawing was a part of the Report on the UNIVAC; the subject matter of EM–20 is disclosed in, and therefore anticipated by, the Report on the UNIVAC but such Report was not brought to the attention of the EM–20 examiner by defendants or their predecessors.

14.11.1.32 SR has admitted that the subject matter claimed in the EM–39 through 44 and 48 applications was embodied in the Census UNIVAC system turned over to the U.S. Census Bureau during March, 1951; the Report on the UNIVAC described the Census UNIVAC system in comprehensive detail; there were some changes made to the Census UNIVAC system after the Report was made; however, these changes do not materially affect the Report's disclosure of the subject matter of EM–39–44 and 48; in view of the foregoing, the Court finds that the Report on the UNIVAC anticipates the EM–39 application and the EM–40–44 and 48 patents.

14.11.2 *Public Use and On Sale*

14.11.2.1 Eckert, Mauchly, and EMCC placed an electrostatic information storage system claimed in the EM–8 application and patent in public use and on sale in the United States more than one year prior to the application filing date.

14.11.2.1.1 During January, 1948, EMCC demonstrated to personnel of the U.S. Bureau of Standards and the U.S. Bureau of Census a model of an electrostatic information storage system which Eckert and Herman Lukoff had built.

14.11.2.1.2 During January, 1948, the electrostatic information storage system was demonstrated to Standards and Census personnel, including Messrs. Cannon and Alexander, to induce them to enter into a contract with EMCC for the purchase of a UNIVAC computer.

14.11.2.1.3 During the demonstration, the storage system was operated, and Cannon and Alexander observed the memory effects achieved by the storage system.

14.11.2.1.4 During the period of time in which EMCC was demonstrating the electrostatic information storage system, it was negotiating with the Bureau of Standards for additional contracts to develop a computer having an information storage system.

14.11.2.1.5 The demonstration of the electrostatic information storage system for the commercial purpose of inducing Standards and Census officials to enter into a contract to develop a computer put the system on sale and in public use.

14.11.2.1.6 On June 10, 1949, Eckert filed an application describing the electrostatic information storage system demonstrated during January 1948, designated Case EM–8, that resulted in U.S. Patent No. 2,969,478 (the '478 Patent).

14.11.2.1.7 On June 10, 1949, Eckert knew that subject matter claimed in the EM–8 application was embodied in the electrostatic information storage system demonstrated to Bureau of Standards personnel during January, 1948.

14.11.2.2 EMCC placed a binary adder claimed in the EM–14 application and patent in public use and on sale in the United States more than one year prior to the application filing date.

14.11.2.2.1 By December 23, 1947, EMCC had built a demonstration model of a binary adder of the type described in a Report on the UNIVAC.

14.11.2.2.2 The binary adder demonstration model also comprised a cycling unit in the form of a test word generator that generated pulses representing numbers for the binary adder to count.

14.11.2.2.3 On or about December 23, 1947, Mauchly informed the Bureau of Standards that it was possible to demonstrate the binary adder model.

14.11.2.2.4 During January, 1948, a large number of people from the U.S. Bureau of Census and the U.S. Bureau of Standards visited EMCC and observed demonstrations of the binary adder model.

14.11.2.2.5 During March, 1948, the binary adder model was publicly demonstrated by EMCC to numerous persons at a convention of the Institute of Radio Engineers held in New York, New York.

14.11.2.2.6 The purpose of the demonstrations of the binary adder model was to interest the viewers in the purchase of the BINAC or UNIVAC computers then being developed by EMCC.

14.11.2.2.7 The demonstrations of the binary adder model put the subject matter of the model in public use and on sale, in the United States.

14.11.2.2.8 On April 13, 1950, Eckert filed an application designated Case EM–14 that resulted in U.S. Patent No. 2,687,473 (the '473 Patent).

14.11.2.2.9 The binary adder demonstration model included apparatus essentially the same as the apparatus described and claimed in the EM–14 application and patent.

14.11.2.2.10 On April 13, 1950, Eckert knew that the binary adder model had been publicly demonstrated during March 1948, and that the test word generator of the adder was essentially the same as the apparatus described and claimed in the EM–14 application.

14.11.2.3 EMCC placed the BINAC computer claimed in the EM–22 application in public use and on sale in the United States more than one year prior to the application filing date.

14.11.2.3.1 During October 1947, Electronic Control Company, a partnership of Eckert and Mauchly and a predecessor of EMCC and SR, entered into a contract to manufacture and sell a BINAC computer system to Northrop Aircraft, Inc.

14.11.2.3.2 The BINAC computer system consisted of two identical BINAC computers capable of simultaneous and independents operation upon the same problem in such a way that their reliability could be tested by direct comparison of their outputs.

14.11.2.3.3 Beginning in late August, 1948, EMCC periodically offered BINAC computers for sale and demonstrated the Northrop BINAC computers to prospective customers, thereby putting subject matter embodied in each Northrop BINAC computer on sale and in public use in the United States.

14.11.2.3.4 On or about August 12, 1948, the production of the first Northrop BINAC computer was complete.

14.11.2.3.5 On or about September 9, 1948, the production of the second Northrop BINAC computer was complete.

14.11.2.3.6 On September 10, 1948, Mauchly, president of EMCC, offered to sell to the University of Illinois a BINAC computer identical to the Northrop BINAC computers.

14.11.2.3.7 Eckert was informed at the time about this offer to sell a BINAC computer to the University of Illinois.

14.11.2.3.8 During November, 1948, a Northrop BINAC computer was demonstrated to representatives of the U.S. Air Controllers Office and the Council of Economic Advisors to the President of the United States.

14.11.2.3.9 During the spring of 1948, EMCC asked for and received permission from Northrop to demonstrate the Northrop BINAC computers to additional prospective customers.

14.11.2.3.10 During the spring and summer of 1949, prior to August 16, 1949, the Northrop BINAC computers were demonstrated to many potential customers by EMCC for the purpose of selling computers.

14.11.2.3.11 Prior to August 16, 1949, visitors at the EMCC plant viewed the same type of BINAC demonstrations later given to the press and invited guests at public demonstrations held during the third week of August, 1949.

14.11.2.3.12 One of the demonstrations involved the solution of a Poisson equation which was a real and practical problem.

14.11.2.3.13 Prior to August 14, 1949, the purpose of the BINAC demonstrations to visitors was to sell computers.

14.11.2.3.14 During the BINAC demonstrations to visitors, the entire EMCC plant was used as "a gigantic salesroom."

14.11.2.3.15 During the demonstrations, the engineers employed by EMCC cooperated with the attempts of management to sell computers.

14.11.2.3.16 The engineers gave the potential customers any information they wanted about the Northrop BINAC computers.

14.11.2.3.17 During May, 1949, a Northrop BINAC computer was demonstrated to representatives of Hughes Aircraft Company in an attempt to sell Hughes a computer.

14.11.2.3.18 During the week of June 12, 1949, the Northrop BINAC computer system was visited by R. A. Meagher of the University of Illinois.

14.11.2.3.19 During July, 1949, a Northrop BINAC computer was demonstrated to representatives of Fairchild Engine and Aircraft Corporation in an attempt to sell Fairchild a computer.

14.11.2.3.20 On or about July 27, 1949, a Northrop BINAC computer was demonstrated to representatives of A. C. Neilsen Company for commercial purposes.

14.11.2.3.21 Prior to August 16, 1949, EMCC received $20,000 for demonstrating a Northrop BINAC computer to the Prudential Insurance Company of America (Prudential) and for making drawings and specifications of the BINAC computer available to Prudential.

14.11.2.3.22 During December, 1948, EMCC agreed to sell a computer to Prudential on the condition that it be paid $20,000 for disclosing and demonstrating a binary computer to Prudential.

14.11.2.3.23 In order to receive the $20,000 payment, EMCC made available to Prudential complete drawings of a Northrop BINAC computer.

14.11.2.3.24 In order to receive the $20,000 payment, a Northrop BINAC computer was demonstrated to representatives of Prudential on July 29 and August 2, 1949.

14.11.2.3.25 On or about August 3, 1949, EMCC received the $20,000 payment for disclosing and demonstrating a Northrop BINAC computer to Prudential in accordance with the December, 1948 Agreement.

14.11.2.3.26 On August 16, 1950, Eckert and Mauchly field U.S. Application Serial No. 179,782, still pending, designated Case EM–22, that purported to describe and claim one of the two identical Northrop BINAC computers.

14.11.2.3.27 On August 16, 1950, Eckert and Mauchly knew that a BINAC computer had been offered for sale to the University of Illinois in September, 1948, and that the Northrop BINAC computers had been demonstrated to potential customers in the Eckert-Mauchly Computer Corporation plant-salesroom on numerous occasions prior to August 16, 1949.

14.11.2.4 EMCC placed a selecting network incorporated in the Northrop BINAC Computer System and described and claimed in the EM–20 application and patent on sale in the United States more than one year prior to the application filing date.

14.11.2.4.1 On June 24, 1950, Eckert filed an application, designated Case EM–20, that resulted in U.S. Patent No. 2,686,299.

14.11.2.4.2 The EM–20 application described and claimed the encoding and decoding function tables used in the Northrop BINAC computers.

14.11.2.4.3 On June 24, 1950, Eckert knew that subject matter claimed in the EM–20 application covered equipment used in the Northrop BINAC computers and that a BINAC computer identical to the Northrop BINAC computers was offered for sale to the University of Illinois during September, 1948.

14.11.2.5 EMCC placed a UNISERVO tape drive and recording device described and claimed in the EM–19 application and patent in public use and on sale in this country more than one year prior to the application filing date.

14.11.2.5.1 EMCC entered into a Purchase Agreement with Prudential, dated December 8, 1948, for the sale of a UNIVAC system including 12 UNISERVO tape drive and recording devices.

14.11.2.5.2 On May 5, 1949, representatives of Prudential witnessed a demonstration of the UNISERVO device at the EMCC plant and expressed satisfaction with the device.

14.11.2.5.3 On or about May 5, 1949, Eckert was notified that the UNISERVO device had been successfully demonstrated to Prudential, and that EMCC would receive $20,000 for having completed the apparatus.

14.11.2.5.4 On or about May 6, 1949, Prudential accepted a UNISERVO device as complying with Exhibit C of the December 8, 1948 Agreement and paid EMCC $20,000 for having completed the UNISERVO device, thereby placing the UNISERVO device on sale and in public use.

14.11.2.5.5 On July 29, 1950, Eckert filed an application, designated Case EM 19, describing and claiming the UNISERVO device accepted by Prudential in May 1949.

14.11.2.5.6 Preparations for the May, 1949 UNISERVO demonstration received priority from EMCC, because completion of the demonstration would generate income for the corporation.

14.11.2.6 SR's predecessor placed a Census UNIVAC System described and claimed in the EM–39—EM–44 and EM–48 applications and patents on sale and in public use in the United States more than one year prior to the application filing dates.

14.11.2.6.1 During 1948, EMCC entered into an agreement to sell a UNIVAC System (hereinafter the Census UNIVAC System) to the U.S. Government for use by the U.S. Census Bureau; the Census UNIVAC System included a UNIVAC Computer, a UNIPRINTER, a UNITYPER, a CARD-TO-TAPE CONVERTER and other UNIVAC equipment.

14.11.2.6.2 By February 2, 1951, the Census UNIVAC System was completely assembled and under test.

14.11.2.6.3 Prior to March 28, 1951, the Census UNIVAC System was demonstrated to a continual flow of potential customers in the EMCC plant for the purpose of selling UNIVAC Systems.

14.11.2.6.4 During the demonstrations, there was every intent to make the customers aware of the capabilities of the UNIVAC system and there were no orders for secrecy.

14.11.2.6.5 Prior to March 28, 1951, Dr. Albert Auerbach programmed the Census UNIVAC System to solve a genetics problem which was run on the Census UNIVAC System as a demonstration for visitors; the program for solving the genetics problem was of the type actually used in genetics field work.

14.11.2.6.6 Prior to March 15, 1951, SR's predecessor turned over the Census UNIVAC System to the U.S. Government for acceptance testing, thereby placing the system on sale.

14.11.2.6.7 While the acceptance tests were being planned, the Census Bureau dealt with employees of RR.

14.11.2.6.8 There was general agreement between the U.S. Government and RR that passage of any acceptance test meant that the corresponding equipment became the property of the U.S. Government.

14.11.2.6.9 UNIVAC System Test A was passed March 15, 1951; the UNIPRINTER acceptance test was passed during the period of time from March 19 through March 25, 1951; the CARD-TO-TAPE Unit acceptance test was passed and the CARD-TO-TAPE unit was accepted for payment by at least March 27, 1951; UNIVAC System Test B was passed March 30, 1951, thereby completing the last of the acceptance tests.

14.11.2.6.10 Beginning at least by March 20 or March 21, 1951, Census Bureau employees commenced work on actual Census tabulations using the Census UNIVAC System.

14.11.2.6.11 On March 31, 1951, after all the acceptance tests had been passed, the Census Bureau employees just continued to do the same type of tabulations they had been doing before with the help, permission and assistance of employees of SR's predecessor.

[48] 14.11.2.6.12 By turning the Census UNIVAC System over to the U.S. Government for acceptance testing, SR's predecessor put the system on sale.

14.11.2.6.13 On March 28, 1952 Eckert filed an application describing the Census UNIVAC System Pulse Cycling Circuit, designated Case EM–43 that resulted in U.S. Patent No. 2,781,446.

14.11.2.6.14 On March 31, 1952, Eckert filed application Serial No. 279,710 EM–39), still pending, and other applications describing various portions of the Census UNIVAC System designated cases EM–40, EM–41, EM–42, EM–44, and EM–48, that resulted in U.S. Patent Nos. 2,860,756; 2,860,325; 3,133,190; 3,056,947; and 2,748,720.

14.11.2.6.15 Subject matter claimed in each of these applications and patents was embodied in the Census UNIVAC System.

14.11.2.6.16 On March 28 and March 31, 1952, Eckert was aware that the Census UNIVAC System had been sold to the U.S. Government under a contract executed in 1948, that the System had been turned over to the U.S. Government for acceptance testing by March 15, 1951, that the System had been used by Census Bureau employees to run census tabulations prior to March 28, 1951, and that the UNIPRINTER and CARD-TO-TAPE Units had been accepted for payment by the U.S. Government prior to March 28, 1951.

14.11.2.6.17 The Census UNIVAC System was on sale and in public use in the United States prior to March 28, 1951.

14.11.2.7 SR's predecessor placed a high-speed printer described and claimed in U.S. Patent Nos. 2,842,663 ; 2,915,966 and 2,938,193 on sale and in public use in the United States more than one year prior to June 10, 1955, the earliest filing date of the applications resulting in these patents.

14.11.2.7.1 Prior to March 31, 1954, units of the high-speed printer were delivered for installation in customers' offices, thereby putting the high-speed printer on sale and in public use.

14.11.2.7.2 The high-speed printer claimed in U.S. Patent Nos. 2,842,663 ; 2,915,966 and 2,938,193 was placed on sale and in public use prior to March 31, 1954.

14.11.3 Subject matter claimed in the EM–1 patent was derived from Atanasoff.

14.11.3.1 On October 31, 1947, Eckert and Mauchly filed an application describing various memory systems, designated case EM–1, that resulted in U.S. Patent No. 2,629,827 (the '827 patent).

14.11.3.2 Subject matter claimed in the EM–1 application as the joint invention of Eckert and Mauchly was disclosed to Mauchly by Atanasoff in June of 1941.

14.11.3.3. In one embodiment of the EM–1 application, information is stored in a coded sequence of pulses, the pulses being temporarily recorded on a rotating carrier as electrostatic charges, carried by rotation to another station where they give rise to electrical potential pulses which are handled through an external feedback circuit for replacement or reinforcement of the pulses on the carrier.

14.11.3.4 This subject matter as claimed in the '827 patent was anticipated by the disclosure contained in the Atanasoff manuscript disclosed to Mauchly.

14.11.3.5 Atanasoff's concept of the recirculating or regenerative memory was used in the EDVAC program, with Atanasoff's rotating electrostatic charge carrier being replaced by the recirculation of pulses through an electrical delay line ; this delay line version of a recirculating memory was disclosed in the EM–1 application as an embodiment of Eckert and Mauchly's invention.

14.11.3.6 The Atanasoff electrostatic charge version of a recirculating memory was also disclosed in the EM–1 application as yet another embodiment of Eckert and Mauchly's alleged invention.

14.11.3.7 In October 1953, after the '827 patent was granted on the EM–1 application, Eckert stated that prior to 1942, Atanasoff had developed what was probably the first example of what could be termed regenerative memory ; Eckert's knowledge of Atanasoff's prior work was based on what Mauchly had earlier told him.

14.11.3.8 On April 1, 1964, SR charged Control Data Corporation with infringement on the '827 patent (EM–1).

14.11.3.9 On February 2, 1965, SR charged Patter Instrument Company with infringement on the '827 patent (EM–1).

14.11.3.10 SR also called the '827 patent (EM–1) to other computer manufacturers' attention, including Honeywell, as a part of its basic EDP patent portfolio.

14.11.4 Incomplete Execution of the EM–14 and EM–22 Applications.

14.11.4.1 Albert Auerbach, an engineer formerly employed by EMCC, was misled by the legal department of SR's predecessor into signing the EM–14 oath of inventorship without being given an opportunity to determine what was claimed in the EM–14 application ; Auerbach was not provided with the claims of the EM–14 application before he was asked to sign and did sign the EM–14 application oath ; as of September 10, 1971, Auerbach had never seen the claims filed with the EM–14 application.

14.11.4.2 Albert Auerbach and Wilson, another engineer formerly employed by EMCC, were misled by the legal department of SR's predecessor into signing the EM–22 oath of inventorship without being given an opportunity to determine what was claimed in the EM–22 application ; neither Auerbach nor Wilson was

provided with the claims of the EM 22 application before each was asked to and did sign the EM–22 application oath.

14.11.5 Co-inventor omitted from the EM–43 patent.

14.11.5.1 Part of the subject matter claimed in the EM–43 patent was invented by Paul Winsor who was not named therein and whom the Court finds to be a credible witness.

14.11.5.2 Paul Winsor invented some of the apparatus described and claimed in the EM–43 patent.

14.11.5.3 Paul Winsor invented the 27 Pulse Delay Line arrangement shown in Figures 5 and 13 of the EM–43 patent.

14.12 In view of the statement by plaintiff that the Court need not decide that any individual patent is invalid, I make no such finding of invalidity.

14.12.1 Honeywell has stated that the Court need not decide that any of these 30A patents and applications is invalid.

14.12.2 Accordingly, the Court expresses no opinion on the technical validity or invalidity of these 30A patents and applications and confines itself to the questions of unenforceability of the 30A patents issued and pending as against Honeywell, and whether Honeywell has proven a Sherman Act violation based on alleged willful and intentional fraud on the Patent Office concerning these patents and applications.

14.13 I find disturbing the fact that with the rejection and abandonment of EM-27 based on the June 30, 1946 EDVAC Report the applicants or their counsel did not call this report to the attention of other examiners in Division 23.

14.13.1 The EM–21, 23 and 25–29 patent applications all were prepared from the EDVAC Report by attorney Eltgroth who represented SR's predecessors.

14.13.2 The earliest of the EM–21, 23 and 25–29 applications to be filed was not received by the Patent Office until October 21, 1950.

14.13.3 The EM–27 and EM–28 applications were both assigned to Division 23 of the Patent Office for examination; the EM–21, 23, 25, 26 and 29 applications were assigned to Division 51 of the Patent Office for examination.

14.13.4 Attorneys for SR's predecessors, Eltgroth and Light, handled all the prosecution of these applications.

14.13.5 Through his own efforts, the EM–27 patent examiner in Division 23 uncovered the EDVAC Report and found that the EDVAC Report was a printed publication within the meaning of the patent statute prior to October 21, 1949, thereby barring patent protection for the EM–27 application.

14.13.6 This finding of the EM–27 examiner was agreed to by Light and was confirmed by information from RR's ERA subsidiary and from Libman; nonetheless, an amendment attempting to eliminate the report as a reference was filed.

14.13.7 A second examiner repeated the rejection, affirmed the finding that the EDVAC Report anticipated EM–27, and stated that the materials submitted with the amendment were "incomplete and consequently misleading"; no further action was taken and EM–27 was abandoned.

14.13.8 After the critical nature of the EDVAC Report had been pointed out to them by the EM–27 examiner, Light and Eltgroth continued prosecution of the EM–23, 25, 26 and 29 applications which Eltgroth had based directly on the anticipatory EDVAC Report.

14.13.9 The EM–21, 23, 25, 26 and 29 applications were handled by examiners outside Division 23 who did not locate and cite the EDVAC Report against these applications; there is no evidence that these examiners were aware of the EDVAC Report; neither Eltgroth nor Light informed such examiners about the EDVAC Report or of the EM–27 examiner's adverse ruling based on the EDVAC Report.

14.13.10 When the EM–29 patent was drawn into an interference, Light and Eltgroth relied on the EDVAC Report to establish prior inventorship but withheld information which they had of the fact of the Report's publication.

14.13.11 Light and Eltgroth relied on the EDVAC Report as proof of invention of EM–28, but withheld information about the fact of its publication and the EM-27 examiner's prior adverse ruling based on it; despite the reliance upon the EDVAC Report as a publication by the EM–27 examiner, Light and Eltgroth submitted an affidavit to the EM–28 examiner to antedate and avoid a prior art reference cited in the EM–28 case; in the affidavit in this respect, Eckert and Mauchly attempted to establish prior invention by relying on a drawing copied from the EDVAC Report; the EM–28 examiner was never told, however, that the EDVAC Report had already been found to be printed publication by the EM–27 examiner in Division 23.

14.13.12 Based on the affidavit, the EM–28 examiner withdrew his rejection and relied instead on another prior art reference (Moore School Lecture Series No. 46) as anticipating all claims of the EM–28 case; this was on June 16, 1953, and Eckert and Mauchly and RR then abandoned the EM–28 application.

14.13.13 The published Moore School Lecture Series also anticipated cases EM–21, 25 and 26; yet, even after the fact of publication was established by the EM–28 examiner, Eckert and Mauchly's attorneys continued to withhold knowledge of the Lecture Series from one Division 51 examiner handling EM–25 and from another Division 51 examiner handling EM–26.

14.13.14. EM–21 had already issued when the EM–28 examiner uncovered the published Lecture Series; however, neither Eckert nor Mauchly nor their successors have ever made any attempt to call the published Lecture Series to the attention of the Patent Office in connection with the EM–21 patent or to dedicate or disclaim the patent or any portion thereof.

14.14 I find and conclude that as yet defendants have threatened no harm to plaintiff, that plaintiff has not proved injury, that plaintiff has failed to prove willful and intentional fraud on the Patent Office by clear and convincing evidence, and that plaintiff has failed to prove an illegal monopoly in restraint of trade.

14.14.1 Honeywell has proven no actual or threatened injury to its business or property caused by any of the 30A patents and applications it has challenged.

14.14.2 Defendants have not directly charged Honeywell with infringement of, or specifically demanded royalties on, any of the 30A patents and applications.

14.14.3 Honeywell offered no evidence that it tried to design around any SR patent or altered its conduct because of an SR patent or application. Honeywell has not admitted that it designed any of its EDP machines to avoid any of the claims of the 30A patents and applications.

14.14.4 Honeywell has failed to prove willful and intentional fraud on the Patent Office in connection with any of the 30A patents and applications.

14.14.5 Findings 14.11–14.11.5.2 and 14.13–14.13.14 as to the infirmities in the 30A patents and applications and evidence tendered by Honeywell with respect to the SR–IBM August 21, 1956 cross-licensing and exchanging technical information which included the 30A patents and applications and which was an unreasonable restraint of trade in violation of Section 1 of the Sherman Act as found in 15.25 and 15.37 provide grounds for declaring the issued and pending 30A patents unenforceable.

14.14.6 "It is not the mere obtaining of a fraudulent patent which brings antitrust liability to its owner; it is the assertion or enforcement of the issued patent acquired by fraud which creates antitrust liability."

[49] 14.14.7 One who has not yet been charged with infringing a patent may have standing as private attorney general to seek a declaration that it is invalid or unenforceable as may be necessary to fit the exigencies.

14.14.8 Honeywell has proven that SR violated Section 1 of the Sherman Act in connection with the August 21, 1956 Agreement with IBM which licensed the 30A patents and patent applications, but has not proven that any of these 30A patents or patent applications has injured Honeywell in its business or property.

15. SR–IBM August 21, 1956 Agreement

15.1 Plaintiff has stated its claim that defendants violated the antitrust laws in a variety of ways and I am not certain beyond the broad claims of violation what the exact claims may be.

15.2 I believe the claims to be somewhat as follows:

15.3 Plaintiff claims that this agreement effected a technological merger between the two companies then in control of about 95% of the EDP business.

15.3.1 Honeywell claims that on August 21, 1956, SR and IBM entered into a massive settlement and patent cross-license Agreement in the TAB and EDP fields [hereinafter the "1956 Agreement"] and shared proprietary and nonpatented design and manufacturing technology thereunder which effected a practical merger thereof between SR and IBM; Honeywell claims also that at that time SR and IBM controlled about 95% of the EDP business and became conspirators.

15.3.2 See 15.24.

15.4 Plaintiff claims that the two companies shared their technological portfolios by cross licenses and exchanged know-how.

15.4.1 See 15.25.

15.5 Plaintiff claims that they further settled interferences with respect to ENIAC and SSEC and other patents and applications which they then knew to be invalid.

15.5.1 See 15.24.

15.6 Plaintiff claims that in substance that the agreement was anti-competitive and that defendants violated Section 1 in that they unreasonably restrained competition and this restraint violated the per se standard or the rule of reason.

15.6.1 Honeywell claims that SR, together with IBM, unreasonably restrained competition by entering into and performing the 1956 Agreement and technological merger and that such action was a per se violation of Sherman 1.

15.7 With respect to Section 2, plaintiff claims that defendants effected or attempted to effect monopoly power in the relevant market with an intent or purpose to exercise that power.

15.7.1 Honeywell also contends that SR, its constituent corporations and ISD, effected, attempted to effect, and, together with IBM under the 1956 Agreement and technological merger, combined and conspired to effect monopoly power in the relevant market in violation of Sherman 2.

15.8 Plaintiff claims that monopoly power is the power to control prices or exclude competition.

15.8.1 Honeywell claims that power to control prices or exclude competition may exist by virtue of a jungle of patents and technology which creates substantial barriers to competitive entry or burdens the competition after entry by affecting costs.

15.9 Plaintiff claims that it was thus forced to compete in an artifically and illegally infected and structured market or in an artificially impacted market.

15.10 Plaintiff claims that by the alleged misconduct that defendants intended to dominate the EDP market and that defendants performed such acts intentionally and with an ultimate anti-competitive goal.

15.10.1 Honeywell's claim of misconduct by defendants included that of conspiring with IBM in 1956 and 1965 and with BTL in 1961 under the leverage of ENIAC application or patent which created a jungle of patents and technology.

15.11 Plaintiff suggests that there was a less restrictive alternative which defendants did not choose.

15.12 Plaintiff claims that though the agreement was labelled non-exclusive, that it was nonetheless exclusive and secret.

15.13 In 1956 the EDP industry was in its beginning stages.

15.13.1 Remington Rand (Remington Rand and Sperry Corporation were consolidated in 1955 to form SR) entered the computer business in 1950 by acquiring the Eckert-Mauchly Computer Corporation, which had been formed by Eckert and Mauchly.

15.13.2 In 1953, Remington Rand acquired another EDP company, Engineering Research Associates, Inc.

15.13.3 IBM had been the dominant force in the tabulating machine business, and in the early 1950's was preparing to enter the computer business.

15.13.4 The commercial computer industry originated in the EDP systems offerings of Remington Rand and IBM shortly after 1950; in the early 1950's, IBM was offering the 650, 701, 702, 704 and 705 EDP systems and Remington Rand was offering the UNIVAC I and 1103 EDP systems.

15.13.5 While the Government's 1952 suit against IBM was pending, the EDP industry began to emerge.

15.13.6 Because of its acquisition of the Eckert-Mauchly Computer Corporation in 1950, and Engineering Research Associates in 1953, Remington Rand and its UNIVAC division had an early lead in EDP; however, it soon lost this lead to IBM.

15.13.7 In the period 1955 1956, other companies besides SR and IBM, including Honeywell, began to move seriously into the electronic data processing field but basically IBM and SR still dominated it.

15.13.8 By 1956, several other companies were beginning to develop and offer EDP systems. Honeywell was working on a large computer, the D–1000, which was first shipped at the end of 1957, and NCR, having acquired an EDP company, was also working on a computer, first shipped in 1959.

15.13.9 In April 1955, Honeywell formed its joint venture with Raytheon to develop, produce and market EDP systems.

15.13.10 NCR acquired Computer Research Corporation in 1953–54 and began design on the NCR 303 (later 304) EDP system to be offered for business applications.

15.13.11 Burroughs acquired ElectroData Corporation in 1956, inherited and marketed ElectroData's 205 EDP system, and had begun designing its 220 EDP system for business applications.

15.13.12 RCA had already marketed its BIZMAC system by 1956 and was planning its 501 system which was intended for commercial applications.

15.14 For many years IBM had dominated the tabulating machine industry and had a substantial sales force.

15.14.1 In 1956, IBM was recognized as the principal U.S. supplier of 80 column TAB card equipment and SR as the principal U.S. supplier of 90 column TAB card equipment; both of these companies had years of experience and know-how, both in design and production areas.

15.14.2 The tremendous customer base which IBM had because of its domination of the tabulating industry had a good deal to do with its position in the early days of the EDP industry and this, combined with the information exchange, gave them the predominant role which has tended to perpetuate itself.

15.14.3 IBM used its dominant position in the tabulating business—particularly its large sales and service force—to quickly seize the lead in the EDP business.

15.15 IBM and SR in 1956 had about 95% of the EDP business.

15.15.1 In terms of total revenue (stated in dollars) and market shares (stated as percentages of the total revenue of the industry), SR and IBM had the following shares of the EDP market in 1956:

	World market		Domestic market	
IBM	$42,174,000	42.9	$39,276,000	47.5
SR	50,329,000	51.2	37,590,000	45.5
IBM and SR	92,503,000	94.1	76,866,000	93.0

15.15.2 In terms of the retail sale value of new EDP systems shipped (stated in dollars) and market shares (stated as percentages of the total value of shipments in the industry), SR and IBM had the following shares of the EDP market in 1956:

	World market		Domestic market	
	Amount	Percent	Amount	Percent
IBM	$160,036,800	85.2	$157,138,800	84.9
SR	18,270,000	9.7	18,270,000	9.9
IBM and SR combined	178,306,800	94.9	175,408,800	94.8

15.15.3 In terms of the retail sale value of units of systems outstanding in the marketplace at year end (stated in dollars) and market shares (stated as percentages of the total value of units of systems outstanding in the industry), SR and IBM had the following shares of the EDP market in 1956:

	World market		Domestic market	
	Amount	Percent	Amount	Percent
IBM	$205,568,600	75.7	$202,851,600	75.3
SR	50,190,000	18.4	50,190,000	18.6
IBM and SR combined	265,758,600	94.1	253,041,600	93.9

15.16 Several other companies had 1% or 2% of the business.

15.16.1 In terms of total revenue (stated in dollars) and market shares (stated as percentages of the total revenue of the industry), the other EDP companies had the following shares of the EDP market in 1956:

	World market		Domestic market	
	Amount	Percent	Amount	Percent
RCA	$1,583,000	1.6	$1,583,000	1.9
Burroughs	4,184,000	4.3	4,184,000	5.1
Others	0	0	0	0

15.16.2 In terms of the retail sale value of new EDP systems shipped (stated in dollars) and market shares (stated as percentages of the total value of shipments in the industry), the other EDP companies had the following shares of the EDP market in 1956:

	World market		Domestic market	
	Amount	Percent	Amount	Percent
RCA	$4,200,000	2.2	$4,200,000	2.3
Burroughs	5,406,450	2.9	5,406,450	2.9
Others	0	0	0	0

15.16.3 In terms of the retail sale value of units of systems outstanding in the marketplace at year end (stated in dollars) and market shares (stated as percentages of the total value of units of systems outstanding in the industry), the other EDP companies had the following shares of the EDP market in 1956:

	World market		Domestic market	
	Amount	Percent	Amount	Percent
RCA	$4,200,000	1.5	$4,200,000	1.6
Burroughs	11,782,050	4.3	11,782,050	4.4
NCR	280,056	.1	280,056	.1
Others	0	0	0	0

15.17 In 1956 IBM shipped about 85% of all the new business and SR about 10%.

15.17.1 See 15.15.2.

15.18 At the end of 1956 IBM had 75% of all the EDP systems outstanding and SR 18%.

15.18.1 See 15.15.3.

15.19 From 1955 through 1966 SR did not have less than 10% of the EDP business.

15.19.1 In terms of the retail sale value of units of EDP systems *outstanding* in the market place at respective year end (stated in thousands of dollars) and market shares (stated as precentages of the total value of systems outstanding in the industry), the major members of the EDP industry had the following shares of the world (W) and domestic (D) EDP market from 1955 through 1967:

	SR	IBM	Honeywell	RCA	NCR	Burr	GE	CDC	Philco
1955:									
World	31,920	47,372		4,200	280				
Percent	38.10	56.55		5.01	.33				
Domestic	31,920	46,553		4,200	280				
Percent	38.48	56.12		5.06	.34				
1956:									
World	50,190	206,569		4,200	280	11,782			
Percent	18.38	75.66		1.54	.10	4.32			
Domestic	50,190	202,852		4,200	280	11,782			
Percent	18.64	75.32		1.56	.10	4.38			
1957:									
World	81,270	402,872	1,680	4,200	280	19,580			
Percent	15.94	79.01	.33	.82	.05	3.84			
Domestic	81,270	391,238	1,680	4,200	280	19,470			
Percent	16.31	78.54	.34	.84	.06	3.91			
1958:									
World	115,710	566,001	6,720	12,600	280	23,582	1,484		
Percent	15.93	77.92	.93	1.73	.04	3.25	.20		
Domestic	115,710	548,035	6,720	12,600	280	23,205	1,484		
Percent	16.34	77.40	.95	1.78	.04	3.28	.21		
1959:									
World	178,836	778,253	11,760	13,860	1,176	42,437	8,904		
Percent	17.28	75.18	1.14	1.34	.11	4.10	.86		
Domestic	178,836	750,997	11,760	13,860	1,176	42,033	8,904		
Percent	17.75	74.54	1.17	1.38	.12	4.17	.88		
1960:									
World	220,332	1,023,224	11,760	32,970	4,704	47,258	38,328	12,852	16,800
Percent	15.65	72.66	.84	2.34	.33	3.36	2.72	.91	1.19
Domestic	220,332	971,804	11,760	32,970	5,880	46,090	38,328	12,852	16,800
Percent	16.24	71.62	.87	2.43	.43	3.40	2.82	.95	1.24

1961:									
World	303, 156	1, 490, 818	39, 732	60, 690	16, 716	53, 835	67, 209	42, 756	25, 200
Percent	14. 44	71. 00	1. 89	2. 89	. 80	2. 56	3. 20	2. 04	1. 20
Domestic	303, 156	1, 355, 232	39, 732	58, 170	14, 530	51, 353	66, 915	42, 756	25, 200
Percent	15. 49	69. 25	2. 03	2. 97	. 74	2. 62	3. 42	2. 18	1. 29
1962:									
World	319, 662	2, 004, 576	62, 706	107, 520	55, 526	59, 781	97, 701	80, 808	31, 920
Percent	11. 34	71. 09	2. 22	3. 81	1. 96	2. 12	3. 46	2. 87	1. 13
Domestic	319, 662	1, 810, 110	58, 380	89, 376	47, 863	57, 354	95, 349	80, 808	30, 240
Percent	12. 35	69. 91	2. 25	3. 45	1. 85	2. 22	3. 68	3. 12	1. 17
1963:									
World	397, 509	2, 764, 129	71, 077	167, 084	108, 648	97, 451	129, 507	151, 851	35 616
Percent	10. 13	70. 46	1. 81	4. 26	2. 77	2. 48	3. 30	3. 87	. 91
Domestic	397, 509	2, 489, 221	64, 701	123, 981	94, 817	90, 794	125, 979	142, 275	33, 936
Percent	11. 15	69. 84	1. 84	3. 48	2. 66	2. 55	3. 53	3. 99	. 95
1964:									
World	570, 759	3, 660, 610	129, 810	204, 937	159, 638	166, 039	169, 538	243, 740	41, 664
Percent	10. 68	68. 46	2. 43	3. 83	2. 99	3. 11	3. 17	4. 56	. 78
Domestic	570, 759	3, 306, 253	118, 915	147, 267	133, 919	147, 737	160, 823	214, 970	93, 984
Percent	11. 79	68. 30	2. 46	3. 04	2. 77	3. 05	3. 32	4. 44	. 83
1965:									
World	728, 932	4, 398, 308	255, 444	236, 204	219, 122	253, 541	228, 588	392, 171	44, 352
Percent	10. 79	65. 10	3. 78	3. 50	3. 24	3. 75	3. 38	5. 80	. 66
Domestic	728, 923	3, 938, 446	231, 874	173, 122	173, 083	217, 018	201, 587	328, 318	40, 488
Percent	12. 08	65. 28	3. 84	2. 87	2. 87	3. 60	3. 34	5. 44	. 67
1966:									
World	1, 006, 114	6, 504, 163	517, 084	338, 217	294, 745	321, 807	372, 592	565, 291	39, 816
Percent	10. 10	65. 30	5. 19	3. 40	2. 96	3. 23	3. 74	5. 68	. 40
Domestic	1, 006, 114	5, 910, 929	464, 134	244, 984	214, 716	271, 117	311, 518	468, 781	35, 952
Percent	11. 27	66. 20	5. 20	2. 74	2. 40	3. 04	3. 49	5. 25	. 40
1967:									
World	1, 246, 925	8, 891, 566	619, 538	541, 338	432, 466	387, 943	431, 557	697, 116	25, 704
Percent	9. 40	66. 98	4. 67	4. 08	3. 26	2. 92	3. 25	5. 25	. 19
Domestic	1, 246, 925	8, 014, 659	555, 936	381, 653	298, 094	346, 223	355, 925	554, 053	21, 840
Percent	10. 59	68. 06	4. 72	3. 24	2. 53	2. 94	3. 02	4. 71	. 19

15.20 In 1967 the percentage was slightly less than 10%.

15.20.1 See 15.19.1.

15.21 In many of these years SR operated at substantial losses.

15.22 Plaintiff claims that the exchange of technological know-how between the two dominant companies in the industry permitted their progress at a much faster rate than the extremely small companies not parties to the agreement.

15.23 Plaintiff claims that the failure to make this information available to competitors caused plaintiff and the other small computer manufacturers to become involved in a re-invention cycle which caused tremendous expenses to the excluded companies, particularly for R & D.

15.24 The agreement was the product of a number of factors, including the 1956 IBM Consent Decree, the 1955 antitrust suit by SR v. IBM, the claim of IBM that SR had infringed a number of its patents, a number of interferences involving ENIAC, the evaluation of ENIAC, the evaluation of the respective patent portfolios, the claim by IBM that the ENIAC was invalid because of public use, and undoubtedly other factors.

15.24.1 On January 21, 1952, the Government filed an antitrust suit against IBM.

15.24.1.1 The Government suit charged IBM with monopolizing the tabulating machine industry and with engaging in various restrictive practices in the conduct of its tabulating machines business.

15.24.1.2 At the time the Government action was filed and for some years thereafter IBM had about a 90 per cent share of the tabulating business and Remington Rand had the remaining 10 per cent.

15.24.1.3 The Government suit charged that one of the methods IBM used to maintain its monopoly was to exclude potential and existing manufacturers of tabulating machines from entering the tabulating industry by monopolizing patents, inventions and technical information relating to tabulating systems.

15.24.1.4 The Goverment suit also charged that IBM had refused to grant licenses under its patents relating to certain key tabulating machines and that Remington Rand had endeavored unsuccessfully to obtain a license under these patents from IBM.

15.24.1.5 In April of 1955, Herbert A. Bergson, former head of the Antitrust Division who had been retained by Remington Rand, submitted a draft consent decree to the Department of Justice.

15.24.1.6 According to Bergson's testimony of what he was told by McNamara, the Department of Justice had solicited Remington Rand's views about the relief to be sought from IBM in March of 1955.

15.24.1.7 Since Bergson was keenly aware that IBM had been using its tabulating monopoly to monopolize the computer industry, the proposed decree he submitted to the Department of Justice applied to EDP as well as to TAB.

15.24.1.8 Eventually, Bergson testified, he came to believe that the Government would not get, via negotiations with IBM, what he considered to be adequate relief from IBM.

15.24.1.9 On December 27, 1955, SR had sued IBM for Clayton and Sherman Act antitrust violations involving, inter alia, EDP and TAB monopoly practices, restrictive practices and the illegal tie-in of purchase of tab cards with the lease of tab systems.

15.24.2 As of January 3, 1956, SR and IBM were involved in seven Patent Office interferences over priority and validity of claims contained in the ENIAC patent application and a few other interferences with others of IBM and SR EDP patents and applications.

15.24.2.1 IBM and SR met in late 1955 and early 1956 to discuss a procedure for facilitating the resolution of these interferences.

15.24.2.2 Eventually, these late 1955 and early 1956 IBM–SR discussions expanded to include discussion of other outstanding differences between the two companies, particularly patent licensing and the SR antitrust suit against IBM. In the discussions SR and IBM considered the possibility of a TAB and EDP patent cross-license and an exchange of know-how.

15.24.3 On January 25, 1956, the United States District Court for the Southern District of New York approved a consent decree entered in the case of United States v. IBM.

15.24.3.1 The 1956 consent decree contained numerous remedial provisions directed at the IBM tab and EDP monopoly.

15.24.3.2 In section IV of the decree, for example, IBM was required to offer for sale as well as lease all of its tab and EDP machines.

15.24.3.3 In section IX of the decree, IBM was required to afford certain applicants (other than agents or employees of a manufacturer of tab or EDP machines) the opportunity to obtain training to repair and maintain IBM tab and EDP machines and to furnish to such applicants repair and maintenance manuals and instruction books on all IBM tab and EDP machines. IBM was also required pursuant to section IX to furnish such repair and maintenance books and manuals to owners and lessees of IBM machines.

15.24.3.4 Regarding patents, section XI of the consent decree required IBM to license any applicant under any, some or all IBM's tab and EDP patents and applications filed prior to 1961. IBM was permitted to charge a reasonable royalty for most patent licenses, but section XI of the decree also stated that if the applicant and IBM were unable to agree on what constitutes a reasonable royalty, either could apply to the Court for such a determination (with the burden on IBM to prove reasonableness).

15.24.3.5 Section XI of the decree opened the injunction so as to permit IBM to grant patent licenses under future tab and existing or future EDP patents on the applicant's granting fair value to IBM, as a reasonable royalty, including licenses under any, some or all of the applicant's patents.

15.24.3.6 In addition to the information contained in the IBM repair and maintenance manuals required to be furnished applicants under section IX, section XIV of the decree required IBM to furnish any applicant for a patent license with technical information with respect to, and for use in the manufacture of, a list of some 9 8IBM "tabulating machines". Basically, this list (set forth in Appendix A to the decree) of "tabulating machines" included all of IBM's tab line as of January 1, 1956 of which three were electronic, viz., the IBM 604 Electronic Calculating Punch, the 083 Sorter and the 101 Electronic Statistical Machine. The card readers, card punches and other devices covered by the decree were not electronic nor used primarily in or with an electronic data processing system. These were not "EDP systems or machines", therefore, and the consent decree did not provide that the EDP know-how later obtained by SR was to be available to anyone.

15.24.3.7 The technical information to be provided by IBM pursuant to section XIV of the consent decree was to be such as to enable the applicant satisfactorily to manufacture or assemble the tabulating machinery covered thereby. IBM was permitted to charge applicants only for the cost of reproducing the technical information.

15.24.3.8 Section XIII of the consent decree also prohibited IBM from entering into any agreement or understanding relating to tab or EDP machines or systems which, "provides for disclosure to IBM on an exclusive basis of any invention, formula, process or technical information".

15.24.4 The 1956 consent decree required IBM to grant specifically defined tabulating systems know-how technology, but not EDP systems know-how technology, to certain applicants.

15.24.5 Honeywell executives were aware of the IBM consent decree, and Henry Hanson, Honeywell's EDP patent counsel, prepared a summary of the decree for distribution to selected Honeywell personnel.

15.24.6 Herbert Bergson, one-time Assistant Attorney General in charge of the Antitrust Division, had attempted (for SR) to persuade the Justice Department to include a consent decree provision for a public dedication of IBM's EDP know-how technology in order to correct what he and SR saw as the already noticeable advantage of IBM in the EDP industry.

15.24.7 SR and Bergson considered it necessary, in order to have viable competition in the EDP industry, for all competitors to have royalty-free access to IBM's EDP know-how technology, as well as its TAB know-how technology.

15.24.8 However, SR was unsuccessful in having the EDP know-how requirement included in the consent decree for the public; subsequently it began direct negotiations with IBM to and did obtain the IBM EDP know-how solely for itself.

15.24.9 On March 5, 1956, a conference was held between SR and IBM to discuss the possibility of settlement of the then pending patent and antitrust disputes between the two companies.

15.24.10 Because SR believed that the consent decree January 1, 1956 cutoff date was insufficient, SR suggested that the cutoff date be extended approximately a year and that the definition of technical information be broadened to include EDP, as well as tab.

15.24.11 On May 28, 1956, SR and IBM representatives met to discuss the antitrust problems which might arise out of a then proposed settlement between IBM and SR which included a complete sharing of know-how technology in both the tabulating systems and EDP systems area and a settlement of all Patent Office interferences between the two companies.

15.24.12 At this meeting, IBM submitted a proposal to SR that each company would grant the other a royalty-free, non-exclusive license under all tab and EDP patents and patent applications as of July 1, 1956; each would release the other from liability for past infringement; each would furnish the other, at cost, tab and EDP know-how as of July 1, 1956; IBM would pay $2,000,000 in royalties to SR; and SR would dismiss its antitrust suit.

15.24.13 As part of the negotiations at that meeting, representatives of IBM told SR that neither company would get a patent in the "big interference case" between the IBM "SSEC" computing system and the SR "ENIAC" because of the fact that the ENIAC machine and any alleged invention therein were in public use prior to the critical date.

15.24.14 It was stated by both SR and IBM that it was in the interest of both companies to settle their Patent Office interferences.

15.24.15 Shortly after making its May 28, 1956 proposal to SR, IBM counterclaimed against SR for infringement of 35 patents, mostly in the tabulating area, and it petitioned the Patent Office for the institution of public use proceedings against the ENIAC patent application.

15.24.16 SR management evaluated the IBM May 28, 1956 offer and concluded that EDP should be left out of the settlement. But it remained interested in tab, particularly because it suspected that IBM was holding under wraps an IBM tabulating machine called the World Wide Accounting Machine (for WWAM).

15.24.17 SR officials estimated that patent licenses and technical information on the WWAM machine would be worth $20,000,000 to SR.

15.24.18 SR sent a counter-offer to IBM on June 27, 1956, proposing a tab patent cross-license and an exchange of tab technical information as of December 31, 1956. SR also asked for a $20,000,000 payment by IBM.

15.24.19 SR hoped that the December 31, 1956 cutoff date contained in its June 27, 1956 counter-offer to IBM would be late enough to "catch" IBM's WWAM tabulating machine.

15.24.20 At meetings subsequent to June 27, 1956, SR reduced its offer to $10,000,000 and IBM eventually accepted, but one the basis that the agreement include licenses under IBM and SH's EDP patents and applications (including the ENIAC patent application) and that the cut-off date for know-how be shortened to October 1, 1956. After much discussion, the parties agreed to these arrangements.

15.24.21 Again in the July 1956 negotiations. IBM representatives told SR representatives that IBM's patent counsel, Sanborn, Brumbaugh & Cooper, New York City, had forecast that IBM would prevail ultimately on the public use question and that the ENIAC patent would be invalidated.

15.24.22 At a meeting with SR on July 16, 1956, IBM representatives took the firm position that the ENIAC application had to be a part of any settlement agreement.

15.24.23 At a July 23, 1956 meeting, SR was successful in obtaining IBM's agreement to pay an additional royalty if certain conditions were fulfilled.

15.24.24 A July 25, 1956 draft of the agreement contained a provision for exchange of EDP technical information on machines announced or released to production as of October 1, 1956.

15.24.25 In July of 1956, IBM's top management indicated a concern that the largest patent license deal in history would not be well received by the public.

15.24.26 There were final drafting sessions on August 1 and August 2, 1956. Bergson testified that he had probably reviewed the final drafts of the agreement and orally advised SR that the agreement was lawful.

15.24.27 At the August 2, 1956 drafting session, Bergson suggested that the parties submit a copy of the agreement to the Department of Justice. After the agreement was signed, Bergson personally delivered a confidential copy of the agreement to Marcus Hollabaugh, a Justice Department attorney who had been in charge of the IBM litigation.

15.24.28 In August 1956, a meeting was held between representatives of SR and IBM to work out the procedure for settling major interferences and lesser Patent Office interferences.

15.24.29 Interferences were divided into major and lesser to try to avoid raising antitrust problems over a settlement of major interferences between the

conspirators without presentation of some evidence by IBM; all such showings were essentially a formality.

15.24.30 At this August, 1956 meeting, representatives of IBM again repeated to representatives of SR that the "public use" defense was a good one against the ENIAC patent.

15.24.31 On August 15, 1956 the Assistant Attorney General wrote IBM's counsel and asked for a copy of the agreement. Accordingly, after the agreement was executed on August 21, 1956, IBM's counsel sent a copy to the Assistant Attorney General.

15.24.32 Defendants used their EDP patent and application portfolio in influencing IBM to enter into the 1956 Agreement at a time when the conspirators had about 95% of the EDP market.

15.24.33 On August 31, 1956, IBM and SR entered into a complete cross-license under all their EDP and TAB equipment patents and patent applications, a complete sharing of all EDP and TAB equipment know-how and a complete settlement of all EDP and TAB Patent Office interferences.

15.24.34 The completeness of the August 1956 technology sharing is evidenced by the following excerpt from that Agreement:

"*Exchange of Technical Information.* Sperry Rand and IBM will each, to the extent that it has the right to disclose such information, furnish to the other, as soon as practicable but in no event later than January 1, 1957, all technical information, both domestic and foreign, in its possession as of October 1, 1956, relating to, and for use in the manufacture of tabulating systems and machines and electronic data processing systems and machines which shall have been released to production or announced to the public for sale or lease by it up to and including October 1, 1956.

* * * * * * *

For the purpose of this Section 5, "technical information" shall mean the following information:

(1) a complete set of drawings used in the manufacture of all the detail parts, assemblies, subassemblies, circuits, components, etc., for the product:

(2) a complete set of operation sheets, duplicates of those which the manufacturer used in the manufacture of the product;

(3) a duplicate set of all inspection specifications for parts, assemblies, subassemblies, circuits, components and machines;

(4) a duplicate set of drawings of the tools, jigs, dies, and fixtures necessary for the manufacture of the product;

(5) a bill of all materials necessary for the manufacture of the product and specifications to cover the purchase of such materials; and

(6) illustrated service manuals listing all the detail parts of the product and setting forth mechanical and electrical instructions to enable servicemen to maintain and service machines.

* * * * * * *

In the event that either party shall give the other party notice in writing that the technical information furnished to it is inadequate to enable it satisfactorily to manufacture the commercial end product involved, the other party will supply such further written explanation of the information furnished as may be reasonably necessary for such purpose."

15.24.35 The 1956 IBM–SR Agreement as finally consummated contained, among other things, the following terms:

(a) an exchange of patent licenses on tab and EDP patents and applications as of October 1, 1956;

(b) an exchange of technical information on tab and EDP machines announced to the public or released to production as of October 1, 1956;

(c) a payment of a fixed annual royalty by IBM of $1,250,000 a year for eight years;

(d) a payment by IBM of an additional royalty, if a patent issued on the ENIAC application prior to January 1, 1956, of 1 per cent of the manufacturing cost of each IBM EDP machine embodying any invention covered by the claims of the ENIAC patent manufactured within the United States between October 1, 1956 and October 1, 1964—after deducting the $1,250,000 payments as a credit;

(e) dismissal of SR's antitrust suit against IBM and dismissal of IBM's patent infringement counterclaim against SR.

15.24.36 IBM and SR also on August 21, 1956 entered into a series of procedural agreements to dispose of the various outstanding patent interferences between patent and patent applications of the two companies. These agreements were characterized as "very conventional", and Honeywell (Datamatic) later joined in several of them.

15.25 I find that the cross-license and exchange of technical information agreement was an unreasonable restraint of trade and was an attempt by IBM and SR to strengthen or solidify their monopoly in the EDP industry.

15.25.1 Section 1 of the Sherman Act prohibits "Every contract, combination * * * or conspiracy, in restraint of trade * * *."

15.25.1.1 Nonexclusive patent cross-licensing in itself may be proper.

15.25.1.2 During the negotiation of their 1956 Agreement, both IBM and SR had expressed the view that they were not particularly interested in exchanging EDP know-how (or technical information); each asserted its belief that its own position in EDP was superior to the other's. Nevertheless, a provision for an exchange of EDP technical information—on machines announced to the public or released to production as of October 1, 1956—became part of the agreement.

15.25.1.3 Shortly before the 1956 SR–IBM Agreement was executed, J. Presper Eckert, then a UNIVAC executive, expressed opposition to the agreement. Among other things, Eckert was concerned about the treatment of "some dubious information known as 'knowhow' (whatever that is)". Eckert also wrote:

'A considerable emphasis has been placed on the value of something known as 'know-how' (presumably this means manufacturing drawings, etc.) to us. I cannot find anyone in Engineering who actually knows how we can use this so-called valuable know-how. The only work I know of at IBM which would be of great interest to us would be that of high speed circuity and the study of new electronic storage techniques. Since, however, none of this is at the present time being used or offered for sale we would not get anything on the things that they are doing which would be of real value to us * * *."

15.24.1.4 Notwithstanding Eckert's demurral, the 1956 Agreement was concluded and IBM and SR went about working out details for the exchange of technical information. IBM and SR representatives met again several times in the fall of 1956 for this purpose.

15.25.1.5 Since neither IBM nor SR really knew what it wanted or might expect in the other's technical information, it was ultimately agreed to have a broad exchange. However, a large number of obsolete machines were removed from the lists of machines on which information was to be exchanged.

15.25.1.6 Pursuant to the August 21, 1956 Agreement IBM and SR did, in late 1956, exchange thousands of documents containing proprietary, technological and production know-how of the kinds described in the Agreement with respect to the EDP and TAB systems and machines listed in the Exhibits A to the Agreement; at least as late as 1962, SR requested and received technical information from IBM pursuant to the 1956 Agreement.

15.25.1.7 In the fall of 1956, SR received IBM manuals called for by the agreement and also received the manufacturing information on the IBM 604 Electronic Calculating Punch (a tab machine listed on appendix A to the IBM consent decree). The remainder of the manufacturing information which IBM supplies was received by SR in late December of 1956. After this information was received, it was placed in the custody of Robert Kalb at a UNIVAC facility in St. Paul.

15.25.1.8 The technical information SR obtained from IBM did not disclose design alternatives that had been considered by IBM and rejected, cost data, price data, software, third-party proprietary information or information on IBM's field experience.

15.25.1.9 In October of 1959, McNamara (General Counsel of SR's Remington Rand division) approached IBM's Birkenstock, stating that perhaps the time had come to discuss extension of the 1956 cross-license with an exchange of know-how Birkenstock replied that he did not feel that an exchange of know-how was practical and that:

"We were able to include a know-how exchange in our present cross-license agreement because we had already been required by our Consent Judgment to make January 1, 1956 level know-how available. It was relatively simple for us to merely update it to a level consistent with the date of our cross-license agreement. It would, however, be a tremendously expensive and time-consuming job to update it again to a current level. Furthermore, if we were to make current know-how available to RemRand, we would feel obligated to make it available to others who request it as well. The cost of maintaining the records would be too burdensome."

15.25.1.10 No further exchange of unpatented know-how (or technical information) between IBM and SR was entered into after 1956 except under the patent exchange of 1965.

15.25.2 None of the other EDP competitors ever received either SR's or IBM's EDP know-how.

15.25.3 After receiving the technological and production know-how, from each other, both SR and IBM studied and used the information; SR refused to sell or allow use of any of its equipment made in consequence of the technological merger by any EDP industry member at any price; IBM sold or leased such items at retail prices; by reviewing and studying the technical information shared under the 1956 Agreement, SR and IBM were better able to know and to evaluate the options available to each of them and to decide what equipment to build and how; having such opportunities involves time and cost saving shortcuts in the evaluation and selection of alternative routes.

15.25.3.1 One instance where manufacturing information on an IBM EDP machine was examined by SR was on the IBM RAMAC device.

15.25.3.2 The drawings on the RAMAC were incomplete and, in any case, SR had prior to 1957 already developed considerable competence in random access storage, both disc and drum. Indeed, SR's Appleton patent, filed on February 2, 1955, and licensed to IBM but not to others, discloses an invention bearing a striking similarity to the IBM RAMAC.

15.25.3.3 SR made no specific use of the IBM RAMAC drawings as it could have; instead it continued to follow the drum approach to random access, which it had used prior to 1957.

15.25.3.4 The SR technical information was shipped in late 1956 to IBM's plants at Endicott and Poughkeepsie, New York. The SR EDP material went to Poughkeepsie.

15.25.3.5 An assignment was made in February of 1957 to H. A. Mussell of IBM to review the SR drawings that had been sent to Poughkeepsie. After months of prodding by Mussell's superior, Phelps, a one-page report was ultimately issued on July 8, 1957. The report stated:

"Detailed studies of the subject information were not made since it was felt, in all cases, that the information to be gained would not greatly benefit IBM.

"In all cases, it was felt that the material might have proven more valuable, if:

(1) Information available was better organized.

(2) A key to readily interpreting the Sperry Rand circuit coding were available.

(3) Missing prints and information were available."

15.25.3.6 In September of 1957, Phelps was asked by H. T. Marcy, the head of engineering at IBM's Poughkeepsie facility: "Are we using any of the data we obtained from Sperry Rand as a result of our settlement with them?" Phelps responded:

"For a few weeks * * * there was reasonable activity in that various individuals came to the library and studied parts of the data. For some time there has been almost no activity with these files at Poughkeepsie."

15.25.3.7 In the spring of 1957, IBM was in a "bind" on its high speed printers—they were wire printers giving IBM "fits from a mechanical performance point of view". IBM examined the 1956 SR technical information on the UNIVAC high speed printer, but concluded that IBM should solve its problem by going ahead with its own development, the chain printer. IBM thus eventually elected to introduce its very successful chain printer, which was "as different as day and night, from a functional and mechanical point of view" from the UNIVAC printer. No other mainframe manufacturer had this choice.

15.25.3.8 IBM also examined 1956 SR technical information on magnetic drum plating and magnetic drum bearings. However, IBM found no information that would advance IBM's state of the art and so put the drawings "back in the file and forgot it". No other mainframe manufacturer had this opportunity.

15.25.3.9 IBM put the 1956 SR information into dead storage in 1958.

15.25.3.10 In 1960 J. Svigals, an IBM employee, wrote to Birkenstock:

"Several years ago, I believe the year was 1956, IBM received detailed descriptive material from Sperry Rand. The material described all of their announced products at this time.

"There has been little or no use of this material. As part of this department's File Retention Program, it is desirable that this material be discarded. May I please have your advice on the disposition of this material. Attached is a list describing the contents of these files."

The EDP information which IBM had received from SR was subsequently destroyed and the tab information remained in dead storage at Endicott.

15.25.3.11 IBM could have but never built a copy of any of the SR machines on which it had received EDP technical information and it could have but never used or incorporated into any of its equipment, designs, details, features or processes specifically derived from the SR technical information. No other mainframe manufacturer had such opportunity.

15.25.4 There was a competitive advantage to be gained by both IBM and SR by receiving the respective packages of EDP know-how.

15.25.5 That same competitive advantage was also possible for any other EDP competitor had it received that EDP know-how.

15.25.6 SR and IBM attempted to, and did, gain a competitive advantage by the receipt and subsequent ability to consider and decide upon utilization of that EDP know-how.

15.25.7 Then other EDP competitors, by reason of their non-access to the EDP information, did not gain or have a competitive advantage.

15.25.8 Since SR and IBM gained a competitive advantage and since the other EDP competitors did not, the others were at a competitive disadvantage compared to either SR or IBM or both.

15.25.9 Thus, the effect of the technological sharing, embodied in the 1956 Agreement, and the subsequent use of and ability to use each other's know-how by SR and IBM, was to confer a competitive advantage on the parties and to put the other EDP competitors at a competitive disadvantage with respect to SR and IBM and each of them as they both are held to have realized at the time and thereafter.

15.25.10 Conversely stated, the cause of the other EDP competitors being put at a competitive disadvantage was the technological merger accomplished by the 1956 Agreement, and the subsequent use of and the opportunity and ability to use each other's know-how by SR and IBM which the competitors lacked.

15.25.11 The impact of the total EDP and TAB system technological merger between IBM and SR in 1956 was stifling on the growth of EDP competitors and the EDP industry generally; since 1956, all EDP industry members except IBM and SR (and CDC to a limited degree) have been operating under artificial EDP market constraints imposed by having had to compete against the combined technological portfolios of IBM and SR during the critical starting and developmental period of the EDP industry.

15.25.12 The technological merger between IBM and SR restrained and hampered the EDP industry from growing in time and size, restrained and hampered the ability of other members of the EDP industry to thrive and grow and depressed the incentive to invent within the industry.

15.25.13 Prior to and after the 1956 technological merger between SR and IBM, technological competition was the single most important component of competition among entrants to the EDP industry; in perhaps no other industry has technological development been so important to the success of the participants.

15.25.14 The competitive structure of the EDP industry, particularly prior to 1956, created a substantial incentive toward technological innovation.

15.25.15 The importance of technological competition in the computer industry is illustrated by the large outlays for research and development (hereinafter R & D) made by the various members of the EDP industry.

15.25.16 The R & D expenditures for the EDP divisions of several electronics firms frequently exceeded 10% of total revenues and, in early stages of development, R & D expenditures actually exceed total EDP system revenues.

15.25.17 For example, Honeywell made annual R & D expenditures considerably in excess of its annual world EDP system revenues in the entire period 1955–1960, and in excess of 20% of EDP system revenues in the following five year period 1961–1965.

15.25.18 Even SR, although a party to the technological merger with IBM in 1956, made annual R & D expenditures in excess of 10% of its annual world EDP revenues in all except one of the four years from 1957 to 1960.

15.25.19. Because of the benefits obtained from the technology shared under the SR–IBM Agreement of 1956, both SR and IBM realized a dulling of their individual incentive to innovate which would have continued but for the Agreement.

15.25.20 At the time of the SR–IBM Agreement of 1956, IBM and SR had already developed substantial technological expertise in the EDP field and were the two dominant firms in the tabulating machine market whose customers were the most likely prospects for EDP systems.

15.25.21 Thus, the SR–IBM Agreement of 1956 solidified an already dominant consortium.

15.25.22 The terms of the SR–IBM Agreement of 1956 assured that the dominance of the consortium would persist since the parties agreed to exchange existing know-how and information on developments then in progress as well as future patents.

15.25.23 The SR–IBM technological merger gave SR and IBM a decisive advantage over the actual and potential EDP manufacturers who were not parties to the Agreement and, as a consequence, significantly reduced the competitive potential of outsiders.

15.25.23.1 After the 1956 IBM–SR agreement, SR's share of EDP business declined.

15.25.23.2 Although SR's UNIVAC Division had been claimed to be profitable before the 1956 IBM–SR agreement, it lost $250,000,000 in the 1957–1965 period.

15.25.23.3 In the 1957 to 1967 period, Honeywell, RCA, Contorl Data and NCR grew from having practically no EDP business to having annual EDP shipments each about as large as SR's.

15.25.23.4 In the 1957–67 period, SR spent $223,000,000 (18% of its EDP revenues) on EDP research and development; in the same period Honeywell spent $95,000,000 (21% of its EDP revenues) on EDP research and development.

15.25.23.5 The 1956 IBM–SR patent cross-license was de facto exclusive, and SR conspired and agreed with IBM to prevent Honeywell from obtaining access to any IBM or SR patent licenses and know-how.

15.25.23.6 Honeywell has proven that it was injured in its business or property by reason of the 1956 EDP patent cross-license between IBM and SR.

15.25.23.7 As to licenses under IBM EDP patents, any applicant under the IBM consent decree had a right to obtain such licenses, and Honeywell and the other major EDP companies did obtain such licenses.

15.25.23.8 Honeywell offered no evidence that it ever tried to design around an SR patent or even altered its conduct because of an SR patent. In fact, in answers to defendants' Interrogatories 248 and 251, Honeywell admitted that it never studied any of the SR patents and applications involved in the 1956 IBM–SR cross-license and that it never designed any of its EDP machines to avoid any of their claims.

15.25.24 The SR–IBM technological merger in 1956 injured competition in the EDP industry by conspiratorially allowing the perpetuation of the high combined market share of the two parties to the merger and tending to protect the proportion of each conspirator.

15.26 In 1956 IBM and SR had about 95% of the EDP market and each had a duty to the remaining members of the industry to make full disclosure of the agreement.

15.26.1 SR had the duty to seek out Honeywell and offer it access to technical information equal to that offered IBM.

15.26.2 On May 10, 1956, a meeting was held between IBM and SR at which representatives of both companies discussed a then proposed settlement between SR and IBM.

15.26.2.1 At this meeting, F. J. McNamara of SR stated that as a part of the settlement, he contemplated an exchange of know-how between IBM and SR which would cover the EDP field as well as the TAB systems area.

15.26.3 On May 15, 1956, Birkenstock of IBM sent a letter to outside counsel with an attached copy of suggested points to be negotiated between IBM and SR, including an exchange of EDP know-how.

15.26.4 On May 22, 1956, IBM concluded that the proposed know-how exchange between IBM and SR would raise serious problems under the antitrust laws unless both companies were willing to provide the same know-how to all licensees.

15.26.5 On May 28, 1956, a meeting was held between representatives of IBM and SR to discuss further a proposed settlement between the two companies.

15.26.6 One of the principal points at this meeting was the antitrust problems which might arise out of the proposed settlement.

15.26.6.1 Judge Bromley, outside counsel of IBM, stated that the proposed settlement between the two principal occupants of the field was fraught with antitrust difficulties.

15.26.6.2 McNamara of SR stated that an exchange of EDP know-how would give rise to antitrust problems and that SR was not then disposed towards a know-how exchange.

15.26.7 On June 6, 1956, Birkenstock of IBM and McNamara of SR discussed the fact that should an exchange of know-how be concluded between the two companies, IBM would be obligated to provide EDP know-how, at least coextensive to the patent grant, to all licensees.

15.26.7.1 IBM had made it clear to SR throughout their negotiatons that because of its consent decree, IBM would make available to all competitors who requested it the same patent licenses and technical information it provided to SR. IBM did nothing effectual to implement this requirement.

15.26.8 At a June 20, 1956 meeting with IBM, McNamara stated that, based upon a previous conference with Birkenstock, there was an understanding that the objective of a settlement between IBM and SR was to place SR in such a position with respect to patents, applications and know-how that it would be on the same level as IBM; this was what occurred.

15.26.9 At a June 29, 1956 meeting with SR, Birkenstock of IBM stated that, contrary to the advice of IBM's antitrust counsel, IBM would agree to a cutoff date of June 1, 1956, for an IBM–SR know-how exchange; the ultimate date became October 1, 1956.

15.26.10 Birkenstock further stated that IBM's counsel had advised IBM that it would be obligated to provide to all licensees, with respect to any particular machine, the same know-how exchanged with SR.

15.26.11 The 1956 consent decree required IBM to grant technology access to specifically defined tabulating systems [not EDP systems technology] to certain applicants; Section XIII of the decree also prohibited IBM from exchanging disclosures of technical information on an exclusive basis.

15.26.12 During the course of the 1956 negotiations IBM had become concerned that any settlement with SR, if publicized, might be construed as an admission of guilt to SR's monopoly charges or that SR's salesmen might make unfair use of it in the way they might describe or talk about the agreement. This concern first appears in the "minutes" of a June 29, 1956 SR–IBM negotiating session; these memoranda indicate that IBM and SR then discussed having a joint press release as a possible solution.

15.26.13 An IBM draft agreement dated July 6, 1956 contained an express provision that there should be a joint press release and that the terms and conditions of the agreement would be kept confidential; this draft contained no provision for an exchange of EDP technical information.

15.12.14 In July of 1956, IBM was specifically advised by outside counsel and so told SR, that a know-how and patent exchange with SR would violate the antitrust laws unless IBM made arrangements for other companies in the industry to get the same benefits royalty-free; no provision implementing this necessity was included in the technological merger.

15.26.15 At an August 1, 1956 meeting of IBM and SR representatives, Birkenstock of IBM reported that IBM had been unable to avoid mentioning the settlement negotiations to the editors of Fortune magazine; however, SR representatives were assured that Fortune would not publish any details.

15.26.16 Both companies desired to gain technological peaceful coexistence and expressed their mutual concern over antitrust problems which would arise from the two dominant companies exchanging EDP know-how and patent licenses when these same benefits would not be available royalty-free to the industry; nonetheless, they made their Agreement de facto exclusive.

15.26.17 Both conspirators desired to keep factual information from their competitors and the public concerning the true scope of their proposed technological merger and concealed, to the maximum degree details of the 1956 Agreement, both before and after it was executed.

15.26.18 SR and IBM were naturally sensitive about candid disclosure of the full details of their know-how exchange when they did not heed the warnings of counsel by making the technology available to all; they agreed upon a closely worded and innocuous-sounding press release and agreed that no other comment would be allowed by any representative of either company.

15.26.19 By issuing the jointly drafted press release, SR and IBM appeared to disclose the nature of their settlement, but the press release did not contain enough information to make it self-explanatory nor to prevent it from being misleading as to the true content of the technological merger; the press release was calculated to allay suspicions which the conspirators knew would follow the inevitable leak of information about the deal.

15.26.19.1 The joint press release was issued a few hours after the 1956 Agreement was signed. The release stated:

"Culminating more than a year's negotiations, International Business Machines Corporation and Sperry Rand Corporation today entered into a nonexclusive licensing agreement to exchange licenses to manufacture punched

card accounting machines and electronic data processing machines under the respective patents and patent applications in existence as of October 1, 1956.

"Based on IBM's greater production of these machines, IBM will pay to Sperry Rand a fixed amount royalty of $1,250,000 for eight years as a credit against production royalties, after which time no further royalty payments will be due.

"The two companies also agreed upon a procedure for settling patent interferences now pending in the United States Patent Office and arranged to exchange technical information with respect to punched card accounting and electronic data processing machines announced or released to production prior to October 1, 1956.

"Simultaneously with execution of the above agreements, Sperry Rand withdrew its Anti-trust complaint, filed December 27, 1955, and IBM withdrew its counterclaim, charging patent infringement, filed June 6, 1956.

15.26.19.2 The fact of the 1956 IBM–SR Agreement, but not the details, received publicity:

(a) Versions of the press release appeared in the Wall Street Journal. The New York Times and in trade journals such as Computers and Automation.

(b) The press release was mailed to thousands of IBM stockholders, and an expanded version of it appeared in the 1957 SR Annual Report.

(c) The Wall Street Journal account stated that technical information was to be exchanged on "all data processing and punched card euipment, announced or released for production before October 1."

(d) SR had several hundred copies of the agreement printed; these copies were circulated to SR personnel and some copies went to outsiders.

15.26.20 On August 21, 1956, T. J. Watson, Jr., chief executive of IBM sent a worldwide memorandum to all executives and department managers, district managers, IBM branch managers and plant and laboratory executives in which he specified what could and should be said regarding the technological merger and attached a script with prescribed answers to questions; the script was designed to disclose none of the details of the Agreement.

15.26.21 Although IBM and SR made reference to an exchange of EDP and TAB systems technical information in their jointly drafted press release of August 21, 1956, and a letter to IBM shareholders dated the same date containing the same reference, both companies were careful to disclose no factual details concerning the extent to which IBM and SR had acomplished a practical technological merger by the 1956 Agreement.

15.26.22 At a September 5, 1956 meeting of SR executives, McNamara stated that the privileges of the deal with IBM, including the know-how exchange, were not available to other industry members.

15.26.23 IBM and SR, singly and together, had the duty to explain the 1956 Agreement openly to the other members of the EDP industry and the public and to offer the opportunity to gain access to the joint power base on nondiscriminatory terms; the 1956 Agreement created an affirmative obligation to inform others of the availability of the pooled EDP know-how.

15.26.24 However, neither IBM nor SR ever told any EDP competitor about the extent of the EDP information exchange in 1956, nor did either ever offer any EDP competitor any of the EDP know-how of either company; neither pursued a program of bringing their know-how, patent or application technology into the public domain; neither engaged in any program or plan to make their de facto exclusively shared technology available on any terms to any EDP industry members or the public.

15.26.24.1 SR's executives testified that they had remained entirely willing after the 1956 agreement to discuss patent licensing and technical information with competitors but did nothing overt to make this willingness effective.

15.25.25 In fact, every effort was made by SR and IBM to keep such information from their competitors and the public, and only a limited number of men in each company were given access to the information.

15.26.26 The 1956 Agreement betwen IBM and SR had significant anticompetitive impact on the development of the EDP industry and there was a less restrictive alternative available, namely, to grant the EDP industry access to the technological merger with accompanying freedom to innovate and compete.

15.26.27 IBM and SR were both specifically familiar with how to achieve publication of the availability of know-how as a result of the 1956 IBM governmental consent decree experience; however, neither took any steps reasonably

calculated to publicize the availability of the EDP technology and know-how shared between themslves.

15.26.28 While IBM and SR filed copies of the 1956 Agreement with the Justice Department, they knew and intended that the Justice Department would treat the matter as confidential under the express provisions of the 1956 Consent Decree; it was so treated.

15.26.29 SR knew, before it entered into the 1956 Agreement with IBM, that there was a probability that the technological merger provided for in the agreement between the two then dominant companies in the EDP and TAB industries would violate the antitrust laws.

15.26.30 Therefore, in July of 1956 and thereafter, SR and IBM agreed to and did keep the details of the Agreement secret from the EDP industry and the public; the 1956 technology sharing was regarded by SR to be "company confidential and not to be disclosed"; further, SR and IBM agreed that there would be no publicity regarding any of their technology sharing activities.

15.26.31 Consequently, no industry member actually realized or knew the scope and breadth of the Agreement and information exchange between IBM and SR in 1956 nor until much later.

15.26.32 Honeywell had no actual knowledge or realization of the full significance of the technological merger between SR and IBM or the conspiratorially intended effects thereof until the discovery processes provided by this lawsuit.

15.26.33 The 1956 EDP know-how exchange between IBM and SR, although labeled "non-exclusive" was effectively "exclusive", i.e., de facto exclusive as it was intended by the parties to be.

15.26.34 The true scope of the 1956 Agreement and the breadth of information exchanged was kept secret by the conspirators until unearthed by Honeywell during discovery in this lawsuit in 1969.

15.26.35 When IBM and SR finally, under legal demand, produced copies of the 1956 Agreement in this lawsuit, both demanded that the copies be treated as "confidential" by Protective Orders of the Court.

15.27 Plaintiff knew of the 1956 Agreement, the 1956 IBM Consent Decree, and the 1955 antitrust suit of SR against IBM.

15.28 Though plaintiff knew of the 1956 Agreement, it made no demand then or within a reasonable time thereafter for the agreement or the information contained therein.

15.28.1 Honeywell officials read the press accounts of the 1956 IBM-SR agreement. In fact, Hanson (the head of Honeywell's EDP patent department) in a September 10, 1956 memorandum to Finke (the head of Honeywell's EDP operations) described the 1956 IBM-SR Agreement and wrote:

"There is also alleged to be a mutual exchange of technical information between the two companies in the tabulating machine and electronic data processing machine field."

Hanson also wrote in the same memorandum that the Honeywell system "is capable of outperforming the Univac I and Univac II and they might be interested in obtaining know-how from us".

15.28.2 In late 1956, Honeywell explicitly considered whether it should approach SR or IBM or whether it should stall and wait for IBM or SR to approach Honeywell. It adopted the latter course in the hope that it could in the meantime develop trading stock so that it would not have to pay cash for any IBM or SR patent licenses.

15.28.3 Until this lawsuit, neither Binger (Honeywell's chief executive), Finke nor Hanson ever sought any additional details concerning the 1956 Agreement from IBM or SR, nor did they ever ask to see a copy of the agreement.

15.28.4 Honeywell has never sought any technical information from SR or from IBM.

15.29 If the demand had been refused, legal action in antitrust or other theory would have forced disclosure of the agreement.

15.29.1 See 18.8.

15.30 In 1956 plaintiff knew that SR had a high speed printer and that IBM had RAMAC and knew that it suffered competitively for lack of such devices or information.

15.30.1 See 15.40.49 through 15.40.70 and 15.40.83 through 15.40.94.

15.31 Plaintiff, however, took no legal action in 1956 or within a reasonable time thereafter to eliminate the restraint of trade or continued monopoly power.

15.32 As in Section 7 cases, the Court believes that whatever happened after 1956 has relevance.

15.33 The history of the industry indicates that defendants in no way assumed or obtained a dominant or monopolistic position.

15.34 SR from 1956 to 1967 remained at about 10% of the EDP industry, and in most of those years operated at substantial losses.

15.34.1 See 15.19.1.

15.35 SR and ISD are the defendants in this lawsuit, not IBM.

15.36 The relevant market is the EDP industry and the geographic market is the United States and foreign markets for sales or rentals of EDP products manufactured in the United States.

15.36.1 The relevant product market for purposes of this lawsuit is defined to include those EDP systems and machines falling within the following definition:

EDP System.—Shall mean any machine or group of automatically intercommunicating machine units capable of entering, receiving, storing, classifying, computing and/or recording alphabetic and/or numeric accounting and/or statistical data without intermediate use of tabulating cards, which system includes one or more central data processing facilities and one or more storage facilities, and has either

(a) the ability to receive and retain in the storage facilities at least some of the instructions for the data processing operations required, or

(b) means, in association with storage, inherently capable of receiving and utilizing the alphabetic and/or numeric representation of either the location or the identifying name or number of data in storage to control access to such data, or

(c) storage capacity for 1,000 or more alphabetic and/or decimal numeric characters or equivalent thereof.

EDP Machine.—Shall mean a machine or device and attachments thereof used primarily in or with an electronic data processing system.

All systems and machines falling within the above definition or included in the relevant product market, with the exception of those so-called "special purpose" systems designed to accomplish a specialized task and sold or leased to the United States or any agency or department thereof, as long as no such system was ever offered generally to the public, and with the proviso that business or scientific electronic data processing machines or systems ordinarily sold or leased in the commercial market, which happen also to be sold or leased to the military, the United States Department of Defense or any other United States Government department are included.

15.36.2 The relevant geographic markets for purposes of this lawsuit are the United States and the world market (a combination of the foreign and United States markets).

15.36.3 At least since the early 1950's, there has been a definable relevant market in the development, manufacture, sale, lease, and use of electronic data processing machines and systems (as defined above) in each of the geographic markets (as defined above).

15.37 I find a violation of Section 1 in the agreement.

15.37.1 See 15.24, 15.25 and 15.26.

15.38 Though the agreement was a further attempt to extend the monopoly, I find that in view of later events that defendants did not create any monopoly in violation of Section 2.

15.38.1 Honeywell has failed to prove that SR's participation in the 1956 IBM SR Agreement violated Section 2 of Sherman Act.

15.39 I find that in view of plaintiff's knowledge of the fact of the agreement and of the dominant position of SR and IBM in 1956, that plaintiff failed to act with any kind of diligence in the protection of its interests.

15.40 I find that if the agreement violates the antitrust laws that plaintiff has proved injury.

15.40.1 The creation of the mutually shared pool of technological know-how on the part of SR and IBM, who at the time of the Agreement had about 95% of the world EDP market, placed the other industry members not party to the Agreement, including Honeywell, at a severe competitive disadvantage.

15.40.2 In agreeing to exchange know-how and information on developments, SR assured itself that other EDP manufacturers would confront a decisive technological disadvantage or excessively high R & D costs, either of which would reduce technological competition in the EDP market.

15.40.3 An analysis of the ratio of "imputed rental value" of annual EDP system shipments to R & D expenses for the period 1957–1967 shows that Honeywell's R & D outlays relative to value of shipments were consistently much higher than those of SR.

15.40.4 "Imputed rental value" as herein used means the value arrived at by converting all EDP sale transactions in each year to lease transactions by a formula which spreads the revenue derived from these sale transactions over

a 3½ year period commencing with the first year the revenue was earned; this "imputed" value is then added to the actual lease revenue to obtain the "imputed rental value" (hereinafter "IRV"); this is a valid base for comparison purposes.

15.40.5 From 1957 to 1960, the four years immediately following the SR–IBM Agreement, Honeywell's R & D outlays exceeded total EDP revenues.

15.40.6 During the same period, SR's R & D outlays ranged from 10% to 22% of its EDP revenues.

15.40.7 Although the productivity of a particular R & D investment may not be immediately measurable, it is well accepted statistically that given the fact that a company is investing R & D dollars every year, the ratio of annual revenue or value of equipment shipped to annual R & D expenditures is a valid basis for considering how productive R & D efforts are over a period of time.

15.40.8 It was not until 1965 that Honeywell attained a ratio (4.787) of IRV of EDP systems shipped to R & D costs as favorable as the 4.619 ratio which SR had enjoyed in 1957, the year immediately following the technological merger.

15.40.9 Utilization of the ratio analysis technique makes possible the ascertainment of the competitive disadvantage suffered by Honeywell as a result of the 1956 Agreement in either of two ways: (1) the lower revenues of Honeywell compared to its R & D outlays as compared to SR, or (2) the excess R & D outlays Honeywell was forced to make in order to achieve any given level of revenues as compared to SR.

15.40.10 The competitive disadvantage suffered by Honeywell as a result of the 1956 Agreement (compared with SR's experience) measured in terms of lost IRV in the years 1958 to 1967, ranges from $516,877,000 (calculated with no time lag between R & D spent and IRV earned) to $360,541,000 (one year time lag); generally speaking, this means that had Honeywell's R & D expenditures been statistically as productive as SR's for those years, Honeywell would have generated between $360,000,000 and $517,000,000 more revenue than it actually did.

15.40.11 The competitive disadvantage suffered by Honeywell as a result of the 1956 Agreement (compared to SR's experience) measured in terms of excess R & D costs incurred in the years 1958 to 1967, ranges from $55,314,000 (calculated with no time lag between R & D spent and IRV earned) to $36,871,000 (one year time lag); generally speaking, this means that Honeywell had to spend between $36,000,000 and $55,000,000 more for R & D than SR did in order to generate the same dollar revenue.

15.40.12 The SR-IBM technological merger had the effect of causing a technological lag of several years on Honeywell, and it required unusually high R & D expenditures in an attempt to overcome that lag.

15.40.13 To determine the extent of the injury to Honeywell caused by the 1956 Agreement and the technological sharing thereunder, the nature of that agreement must be evaluated in light of what Honeywell stood to gain from having access to it, or alternatively, what it stood to lose from not having access to it, in terms of its competitive position.

15.40.14 What Honeywell's activities and subsequent competitive position would have been must be compared to what its activities and subsequent competitive position actually were in order to measure the total impact of the technological merger on it; essentially, the extent of the competitive advantage Honeywell would have received must be added to the extent of the competitive disadvantage it actually sustained.

15.40.15 In 1956–57 and thereafter, Honeywell and others of the EDP industry had workable central processing units ["main frames"] but were experiencing substantial difficulties in developing and producing peripheral and input-output devices and were therefore forced to turn to costlier and disadvantageous sources.

15.40.16 Because it recognized its deficiencies in the peripheral areas, Honeywell representatives talked with representatives of SR in 1956 and requested that SR sell Honeywell its high-speed printers and card readers; SR declined to do so on any basis; this equipment was included in technology shared between SR and IBM.

15.40.17 Therefore, Honeywell was obligated to and did ask IBM to supply card readers and punches and went elsewhere to obtain printers.

15.40.18 IBM did agree to lease card punches and readers to Honeywell but only on a full retail price basis, thereby eliminating that part of the EDP system as a potential for profit for Honeywell.

15.40.19 Frm 1957 to 1964, Honeywell leased for re-lease card readers and punches from IBM.

15.40.19.1 Beginning with the Datamatic D–1000, Honeywell's first computer (first shipped at the end of 1957), Honeywell obtained input/output devices from IBM for use with Honeywell central processors. Among the IBM items purchased or leased at retail prices by Honeywell were the IBM 407 printer and the IBM 519 card punch.

15.40.19.2 The IBM 407 printer and the IBM 519 card punch were explicitly listed on Appendix A to the IBM consent decree as items on which IBM was obligated to furnish technical information to all tab patent licensees. Honeywell never sought this 407 and 519 technical information, or any other technical information, from IBM.

15.40.19.3 Binger, Honeywell's chief executive officer, did not know why Honeywell did not invoke the IBM consent decree to get IBM 80 column punched card equipment.

15.40.19.4 At various times over the years since 1956, Honeywell's Capp Smith and Walter Finke complained to IBM about IBM's policy concerning prices on peripherals it was selling or leasing to Honeywell. On such occasions, Birkenstock testified that he countered that Honeywell was free to apply for IBM know-how and build the peripherals itself if it did not like IBM's policy. Birkenstock claimed to have explained to Smith and Finke that IBM would make available to Honeywell all of the technical information, both tab and EDP, that it had made available to SR.

15.40.19.5 In August of 1959, Birkenstock met with Paul Wishart, then Honeywell's President, to discuss the possibility of Honeywell's taking a license under IBM EDP patents.

15.40.19.6 Following his August 1959 discussions with Birkenstock, Wishart advised Finke that IBM's royalty rates were "a great deal more liberal than I had thought they would be". Wishart also stated to Finke:

"I think what he (Birkenstock) was trying to say in a nice way was that he knew we were infringing, and that perhaps the time had come to talk about it * * *. I do not thing there is any occasion to immediately contract him, but when we start delivering (our first computers), we may well be forced to do this."

15.40.19.7 Henry Hanson wrote to Will Freeman, outside patent counsel for Honeywell, about the August 1959 Birkenstock visit Hanson stated:

"As we have discussed previously, we are not desirous of opening any patent discussions at the present time. However, we may not be able to stall indefinitely on this matter. I have been hoping that it would be possible to build up a better picture in the anti-trust area than i have been able to do at the present time * * * I am no planning to put any concentrated effort on this at the moment but to continue on as we have been trying to locate our potential problems may be and building up our own patent portfolio."

15.40.19.8 By March of 1963, IBM and Honeywell had agreed in principle on a patent cross-license that was royalty free but with IBM to receive licenses also under Honeywell's valuable industrial instrumentation patents as a "quid pro quo" for IBM's greater EDP patent position.

15.40.19.9 The final IBM-Honeywell agreement was worked out in an April 1963 session between Will Freeman (late Honeywell patent counsel) and Birkenstock. During this session, Birkenstock claimed, he had a detailed discussion with Freeman concerning IBM's tab and EDP technical information exchange with SR in 1956 and the fact that similar IBM information—as of October 1, 1956—was available to Honeywell.

15.40.19.10 At their April 1963 meeting, Birkenstock said, Freeman advised that since the IBM know-how (technical information) was limited to October 1, 1956 he believed it had little value to Honeywell at the time. Freeman also expressed a reluctance, according to Birkenstock, to request IBM know-how because he did not want to expose Honeywell to the possibility of IBM's asking for Honeywell know-how in the instrumentation field.

15.40.19.11 At his April 1963 meeting with IBM's Birkenstock, Freeman suggested, according to Birkenstock, that the IBM-Honeywell agreement specifically state that no know-how was to be provided by either party; such a provision was incorporated into the agreement.

15.40.19.12 Final drafting of the IBM-Honeywell agreement was concluded, and it was executed in April of 1964.

15.40.19.13 The IBM-Honeywell agreement called for nonexclusive patent cross-licenses on existing "information handling" patents and on patents issuing on applications filed prior to May 1, 1968.

15.40.20 In December of 1964, IBM notified Honeywell that it would no longer lease for re-lease card readers and punches to Honeywell.

15.40.21 That meant that Honeywell was forced to purchase card readers and punches at full list price from IBM in the current year and then wait several years for a return through rental payments of money which was currently paid to IBM for its readers and punches.

15.40.22 Although this placed Honeywell at a significant competitive disadvantage in the EDP market, Honeywell nevertheless continued to buy readers and punches from IBM since SR would not deal on any terms and there was no other alternative pending final completion of design and development of Honeywell readers and punches.

15.40.23. In May of 1966, representatives of Honeywell visited representatives of IBM to ask that IBM reconsider its policy that it would not lease for re-lease readers and punches to Honeywell.

15.40.24 IBM refused to reconsider both policies, SR knowing of IBM policy and vice versa.

15.40.25 From at least as early as 1956–57, it has been very important for an EDP manufacturer to develop its own complete system because customers disliked "split-system responsibility" with one manufacturer maintaining the central processor and one or more others maintaining the peripheral devices.

15.40.26 The purchase or lease of peripheral devices by an EDP system producer from another manufacturer removed that area of the system as a potential profit-maker.

15.40.27 Peripherals have contributed an increasingly greater share of total system price during the period 1955 to 1970.

15.40.28 Peripheral and input-output devices have been and are now critically important to EDP system customers and hence to sales since they determine the "through-put" of the system, the speed and flexibility with which the system can meet the user's needs, and often, the quality of the system user's performance for its customer.

15.40.29 A range of types of peripheral devices (as well as a range of speed and capacity within each type) offered with a central processor permits the selection of the best combination of capability and price for the customer.

15.40.30 The EDP manufacturer with a limited set of peripherals was and is therefore severely limited in its ability to compete.

15.40.31 Since the late 1950's, emphasis has been moving increasingly away from the central processor and toward peripheral capabilities in the EDP customer's comparison of performance of data processing business applications by competing EDP systems.

15.40.32 It is common today, and has been increasingly so since the late 1950's, to refer to a system with apparent limitations in efficiency as "printer-bound" or "input-bound" or "tape-bound" meaning that the speed of a particular peripheral unit is the measure of EDP system performance.

15.40.33 Honeywell experienced substantial deprivation and competitive disadvantage because of nonaccess to the exclusively held technology which IBM and SR shared under the 1956 Agreement.

15.40.34 Although the Honeywell EDP organization had a strong management position and a growing sales capability in 1956/1957, it had little if any specialized know-how with respect to peripheral or terminal equipment design and evaluation or the production of electronic or mechanical units except on a model-shop basis.

15.40.35 Had Honeywell participated in the information sharing between IBM and SR, it would have obtained valuable, needed know-how to supplement that which it already possessed.

15.40.36 With access to the SR–IBM shared technology, the overall course of Honeywell would have changed noticeably; access to the exchanged information would have significantly changed the climate in which business decisions were being made at Honeywell EDP in the areas of management, finance, engineering and marketing during the entire period from 1956 until 1970.

15.40.37 Honeywell would have achieved a strong position as early as the 1960–1964 period if the company's two prime weaknesses had been eradicated in the late 1950's by access to the shared technology:

.1 The lack of production and commercial product experience; and

.2 The lack of knowledge and customer and corporate confidence in the peripheral areas from both a design and production viewpoint.

15.40.38 The following benefits would have accrued to Honeywell from the time Honeywell obtained access to the 1956 knowhow technology:

.1 Electronic products would have been produced at lower costs with better reliability, and EDP systems could have been brought into the market sooner;

.2 Electromechanical products would have been selected with greater discrimination, implemented for better performance, and produced in-house at a much earlier date with greater customer acceptance;

.3 A broader and more reliable product line would have enhanced the image of the company as a full-line vendor of EDP equipment;

.4 A full-line vendor image would have resulted in more customers earlier; and

.5 A broader product line would have attracted more creative design talent to Honeywell employment in both hardware and software areas.

15.40.39 The primary technical strength of the Honeywell organization rested in its central processor design competence rather than in the areas of implementation of designs in reliable, economical or producible hardware.

15.40.40 Honeywell would have profited by access to the merged technology in the areas of memories, central processors, and control units by knowing certainly what had already been discarded as unreliable, uneconomical or otherwise unsuitable.

15.40.41 Brute-force implementation techniques were utilized in the Honeywell D–1000 and H–800 in an attempt to resolve problems which surely had more reasonable solution; however, the pressures of time and lack of design knowledge and experience forced Honeywell engineers to find their own solutions which were often clumsy, expensive, or difficult to reproduce, all of this would have been alleviated from the time of and by access to the merged technology.

15.40.42 Some of the major potential contributions from Honeywell access to the shared technology are in the areas of improved implementation of the conceptual design (better documentation, better packaging, better powering) and in the application of the detailed information to efforts to replace or coexist with equipment of IBM or SR which a potential customer already had; none of these could be supplied by examination of the competing equipment or by "reverse-engineering."

15.40.43 The Honeywell D–1000 systems were built one-by-one by highly trained engineers and technicians, as were the first H–800 systems; access to the merged technology would have ameliorated this condition for Honeywell and the public would have benefited.

15.40.44 Honeywell EDP engineers had little production experience in 1957; particularly, a lack of knowledge of what could be produced in a factory as opposed to a model shop or test laboratory, and a lack of knowledge of what the factory had to know to produce such equipment; the technology shared between SR and IBM covered such matters.

15.40.45 The lack of production experience among Honeywell EDP engineers resulted in the use of older technology when current technology of Honeywell (not equal to that shared between SR and IBM) did not produce reliable products, or resulted in expensive model shop crash redesign programs and other activities tending to increase costs, delay shipment, reduce reliability and damage Honeywell's performance and image.

15.40.46 SR's UNIVAC II and File computer, made accessible to IBM, both were constructed using printed circuit packages; had information on these been available to Honeywell as it was to IBM, Honeywell would have been able to improve both design and documentation by engineers and improvement of procedures and techniques by production personnel; IBM had access to all of this in the technological merger.

15.40.47 The SR–IBM information concerning design and production would have been valuable to Honeywell with respect to connectors, connector techniques, power supply and distribution, cabling and cooling.

15.40.48 Honeywell, having personnel with little knowledge of production techniques, used older technology or over-designed for performance reliability, with the result that the electronic portions of the H–800/1800, 400/1400 and 200, were more expensive to build and operate than competitive equipment, which affected Honeywell's competitive ability in terms of price and customer costs in floor space and environmental condition.

15.40.49 These deficiencies in Honeywell's design implementation, documentation and production know-how would have been substantially eliminated by access to the technology shared between SR and IBM.

15.40.50 These deficiencies resulted in a loss of sales and loss of EDP image because of the deficiencies in technology displayed by Honeywell.

15.40.51 Honeywell's financial losses were reflected not only in lost sales dollars and increased costs for production and repair of hardware, but also a loss in market place status as reflected in the difficulty in hiring quality personnel and gaining access to sophisticated buyers.

15.40.52 As early as 1959, in developing the H–800 system, Honeywell was forced to attempt to achieve compatibility with certain SR and IBM equipment in order to make sales.

15.40.53 In late 1957, Honeywell was weak in the entire area of high capacity, medium-access-time storage when contrasted with the IBM 305 RAMAC and the SR Magnetic Drum File Computer, both covered by the shared technology.

15.40.54 In 1958 and thereafter, the weakness of Honeywell in random access units was increasingly apparent and the competition, including SR, capitalized on that weakness.

15.40.55 Honeywell had few personnel experienced in this branch of EDP technology and any realistic prospect of developing random access equipment from scratch was hopeless.

15.40.56 Honeywell, in 1957 and for several years thereafter, could not have become competitive in this rapidly evolving technological area without a body of technological information on which to build; the shared technology would have provided this know-how.

15.40.57 The Bryant disc memory unit was selected to be the device offered by Honeywell with its systems, although not without reluctance.

15.40.58 Four systems containing the Bryant disc unit were shipped to Honeywell customers, but they did not become acceptable in the general marketplace primarily because of inability to keep them operative in service.

15.40.59 For the immediate future, Honeywell was thus committed to the use of the Bryant disc unit but the difficulties with this unit coupled with the increasing pressure of the market required that investigation of other units be continued.

15.40.60 Honeywell considered as late as 1964, developing a unit using magnetic tape loops to provide a random access capability because of growing indications that IBM 1311 (random access) unit would destroy any possible market success for the Honeywell 400 and also the Honeywell 200; SR and IBM had shared this technology in 1956–57.

15.40.61 Honeywell personnel concluded that wide tape would not be competitive either with the IBM 1301 disc unit or with the IBM 1311 disc pack unit and that Honeywell would need another program for random access mass storage.

15.40.62 Large numbers of important EDP prospects, some of whom already were customers, made it plain in 1964 that they would not continue to consider Honeywell as a supplier because Honeywell was not competitive in random access.

15.40.63 In September 1964, Honeywell was forced to offer to provide IBM 2311 disc pack units with Honeywell systems or be faced with the alternative of continuing to lose orders.

15.40.64 In December 1964, The Bryant disc unit was removed from the product line because of difficulty in operation and the conviction by Honeywell personnel that it was no longer competitive.

15.40.65 Honeywell's attempted internal development of a magnetic card random access storage proved to be a disaster both financially and reputation-wise.

15.40.66 The Honeywell card mass storage project was terminated as a product development in the first quarter of 1966 because Honeywell could not perfect the card storage unit to a point at which it would function reliably: access to the 1956 technology shared by SR and IBM would have provided a substitute whenever access was achieved.

15.40.67 Honeywell immediately instituted a series of orders to CDC for disc pack drive units and began a crash program for control units, both resulting in heavy expenses.

15.40.68 In 1966, Honeywell began its own disc pack development and in 1969 put into production random access equipment of its own comparable to current offerings of disc pack drive units of other vendors; the shared technology anticipated this by over ten years.

15.40.69 Had the IBM 305/355 information been made available to Honeywell in 1957 as it was to SR, the following would have resulted [each year of deferment beyond 1957 would have postponed the results correspondingly]:

.1 Honeywell would have undertaken in 1957 to build random access storage systems starting with the H–800, increasing the customer base and storing up a reservoir of know-how on hardware, software, and systems;

.2 The net result to Honeywell of this development project would have, at least, yielded a workable, acceptable random access storage unit, and the leverage on sales would have been markedly positive;

.3 Honeywell would have avoided involvement with the Bryant units on the 800 and 400 systems.

.4 Honeywell would have avoided the card mass storage debacle which cost it not only money but also time and adverse publicity;

.5 Honeywell would have saved some of the very large disc drive development costs incurred from 1966 to 1970;

.6 Honeywell would have avoided investing a very large amount of money in the purchase of CDC's disc pack drives; and

.7 Honeywell would have avoided involvement with the Bryant units on the 800 and 400 systems.

15.40.70 The loss to Honeywell of not having suitable random access equipment, available by the shared technology, during the first half of the 1960's was substantial and was further complicated by the fact that this was one area where Honeywell was at the mercy of its competitors, IBM and SR.

15.40.71 IBM and SR capitalized on Honeywell's weaknesses by repeatedly taking prospective sales away from Honeywell during a period of potentially substantial Honeywell growth.

15.40.72 With a strong random access unit from the shared technology in its equipment offering, Honeywell's total would have accelerated during the period from 1959 to 1965.

15.40.73 The effect of such equipment offering would have been cumulative since, as Honeywell enjoyed a wave of customer acceptance, it would have received further orders from those who had shown previous hesitancy.

15.40.74 With the addition of suitable random access equipment from the shared technology, it can be seen retrospectively that Honeywell's sales for the H–800 series alone would have tripled or quadrupled, and these sales would have had substantial impact on sales of the H–400 series and later of the H–200 series.

15.40.75 Honeywell had never had a drum storage unit of its own design and manufacture and instead of building on a shared technology base, had been forced to go to other EDP manufacturers for drum storage units whenever a customer demanded such a unit with a Honeywell system.

15.40.76 Often Honeywell was not able to provide a drum storage unit at all when a potential customer demanded one and hence it lost the sale or lease.

15.40.77 Honeywell could have offered a drum storage system on, or earlier than the H–800 and would have with access to the technology shared between SR and IBM in 1957.

15.40.78 Honeywell had no design or production know-how in the area of tab-card handling equipment in the late 1950's and could not afford the gamble of undertaking to design and produce its own tab-card equipment with no base to start from and no guarantee of success.

15.40.79 If Honeywell had had access to the technology shared between IBM and SR in 1957, it could have begun to manufacture tab-card equipment by the end of 1959 with confidence in success and provided its H–800 customers with card equipment of its own manufacture; each year of deferred access cost money and delayed the date of fruition for Honeywell.

15.40.80 Beginning such activity in 1957 would have produced more competitive tab-card products earlier with Honeywell features designed to complement its own system designs.

15.40.81 Without access to the shared technology, Honeywell was not able to deliver a card-reader of its own design and manufacture until May of 1965 after substantial expenditures and difficulties.

15.40.82 Similarly to the card-reader, Honeywell was not able, without access to the shared technology, to deliver a card-punch of its own design and manufacture until mid-1966; access to the shared technology could have accelerated this delivery.

15.40.83 If Honeywell had developed its own readers and punches for delivery with its first H–800 in 1960, based on shared technology, it would have been able

to market an "all-Honeywell system" then with single (not split) system responsibility, and thus would have improved sales, market status and customer base earlier.

15.40.84 With adequate and competitive reader-punch equipment based on shared technology, Honeywell could have retained the profits paid to SR's co-conspirator IBM from which units were obtained at list prices (either leased or purchased); and the money spent in modifying its own equipment to suit the IBM design, such expenditures being non-recoverable since the leases and purchases from IBM were on a full retail price basis, and interface costs could not be passed on to the EDP customer; earlier access to the shared technology would have shortened the period of dependence on IBM.

15.40.85 Assuming access to the shared technology, Honeywell would have acquired over the years after 1957, or after obtaining such access, a competency in engineering, manufacturing and field maintenance which would have become increasingly valuable because of the growing numbers of Honeywell systems and card handling units installed.

15.40.86 With access to the shared technology, Honeywell's revenues would have been increased in the following ways: by selling or leasing an increased number of systems, by making an increased profit on each system sold or leased, and by improving long-range opportunity, starting with the date of access.

15.40.87 From 1955 to 1965, the printer was a weak link in the Honeywell EDP system offering and had a negative impact on the company's image as an EDP equipment supplier for the whole decade.

15.40.88 Print quality was considered carefully when vendor-selections were being made by several potentially large Government and commercial accounts for which business Honeywell bid in 1955–1965.

15.40.89 Honeywell approached SR in 1956 to attempt to buy or lease for release the UNIVAC High Speed (600 lines a minute) printer and SR refused to deal on any terms; this was included in the technology shared between IBM and SR; and, incidentally, the patents on such printers were barred by public use.

15.40.90 Honeywell then decided to offer Anelex printer at an advertised speed of 900 lines per minute.

15.40.91 The Anelex arrangement was a costly and unsatisfactory interlude in Honeywell's search for a solution to its printer problems.

15.40.92 The Anelex printer occupied an inordinate amount of time on the part of Honeywell's systems engineers and designers, and control over the design proved to be of only limited advantage.

15.40.93 By March, 1959, the decision was made to manufacture printers for the 800 system at Honeywell which began a tedious learning process lasting several years for the Honeywell developmental group.

15.40.94 Print quality remained only marginally acceptable through the Honeywell 822, 422, and 206 printers delivered by Honeywell during the period of 1960–1965 and improvements did not come until the Honeywell 222 printer was first delivered in 1965.

15.40.95 Honeywell poured large amounts of money into printer engineering and field maintenance, but its loss was far greater in terms of systems sales or leases lost to competition.

15.40.96 Had the UNIVAC high-speed printer design information and manufacturing drawings shared with IBM been made available to Honeywell in 1957 or later, steps would have been taken to produce the UNIVAC type printer in-house immediately.

15.40.97 The first Honeywell printer would have been designed and produced in-house by the end of 1959 [or later if access to the shared technology had been later] for delivery with the H–800 system which would have been a better product, both in cost and performance, than the printer Honeywell actually delivered with the system.

15.40.98 Assuming access to the shared technology, the print quality of the H–800 or the 400 and the early 200 series printers would have been at least equal to that of SR's UNIVAC printer device and the impact upon sales of the H–800, H–400 and H–200 would have been substantial during the years 1958–1965 when such systems were offered.

15.40.99 In 1957, Honeywell had little know-how on which to build an EDP system manufacturing facility.

15.40.100 The only electromechanical EDP units manufactured by Honeywell prior to 1964 were magnetic tape units and printers with tape units receiving by far the greatest amount of attention.

15.40.101 Had the IBM/SR shared technology been available to Honeywell in 1957 or later, Honeywell engineers would have been able to learn in such areas as optimal assembly techniques, preferred componentry, preferred materials, current manufacturing methodologies and use of special tools and jigs; knowledge in these areas was the product of extensive prior cycles of trial, error, and revision by IBM and SR product engineering and manufacturing personnel by the time of the 1956 Agreement and was shared thereunder; early access by Honeywell would have meant earlier accomplishment by Honeywell.

15.40.102 Had Honeywell had access to the technology exchanged between IBM and SR in 1957 or later, there would have been improvements in Honeywell's production engineering activities, in documentation and implementation of design changes and in manufacturing performance and cost reduction before they were accomplished without access.

15.40.103 Access to core storage stack technology shared between SR and IBM would have increased the ability of Honeywell to choose, work with and evaluate core storage suppliers earlier, which would have resulted in reduced system costs and increased system performance earlier.

15.40.104 Information from service manuals exchanged between IBM and SR in 1957 or later would have benefited Honeywell in the following ways as soon as obtained and thereafter:

.1 In those cases in which IBM equipment would still have been used with Honeywell systems, selection of specific units and cost estimates would have been on a more knowledgeable and effective basis;

.2 Honeywell service manuals, after exposure to IBM and SR manuals, would have been improved;

.3 Adjustment and calibration information necessary to achieve compatibility with IBM and SR terminal and peripheral units respectively would have been more readily available; and

.4 Maintenance tools and test equipment respectively used by IBM and SR would have been available to Honeywell design engineers and would have minimized one of Honeywell's greatest technical problems, namely, disparity between Honeywell maintenance aids and those of IBM and SR.

15.40.105 Honeywell could not have "reverse-engineered" the IBM and SR electronic and electromechanical devices as to which IBM and SR shared information in the technological merger of 1956 and which would have been helpful to it in the period 1957 to date for the following reasons:

.1 It is impossible on small parts to determine what type of metallic material was used, whether steel, brass, bronze, or some alloy;

.2 It is impossible to tell from examination of parts which parts were made by the peripheral device manufacturer and which parts were purchased from vendors and, if some were purchased, it is impossible to tell the sources, purchase specifications and inspection criteria;

.3 It is impossible to tell by examination of the device what kinds of tooling, or machine tools, fixtures, jigs and dies were used by the manufacturer of the device to produce the desired shapes and tolerances;

.4 It is impossible to decipher tolerances and adjustments of intricate electromechanical and electronic parts since the particular machine which is torn down may be in the middle, low or high position within the permissible tolerance range with respect to each part; and competitive tolerance ranges are not known and are impossible to decipher by inspection;

.5 It is impossible to determine by inspection the order of manufacture and assembly and the procedures and finishes used in the manufacture and assembly processes; and

.6 Most important, it is impossible to reproduce any device without making some unintended or intended modifications or adjustments and as soon as any such modification or adjustment is made a part may be moved outside the permissible tolerance range since there is no way of knowing which adjustments are incidental and which are fundamental.

15.40.106 Had Honeywell been given access to the shared technology, a substantial forward momentum would have been delivered to Honeywell at an earlier time when the leverage was much greater; hence, potential beneficial effects from such an exchange to IBM and SR were greater in 1956-57 than they would be today and made it that much more difficult for those who had no access to the shared technology to compete profitably in the year after the exchange.

15.40.107 The following is the actual schedule for production and delivery of the Honeywell H–800, H–400 and H–200 systems:

.1 The first H–800 was delivered on December 31, 1960, but production problems were not resolved until July of 1961;

.2 The H–800 used IBM card readers and punches, had no drum storage unit, had no acceptable disc random access storage unit, and had a significantly inferior Honeywell-built printer;

.3 The first H–400 system was delivered in late December, 1961, but production problems were not resolved until about July, 1962;

.4 The H–400 had acceptance problems in the marketplace and suffered from the same peripheral equipment disadvantages as H–800;

.5 The first H–200 system was delivered in June of 1964 but did not go into volume production until December of 1964 or January of 1965;

.6 The H–200 suffered from split system responsibility in its early years and lacked quality peripheral devices until Honeywell was able to deliver its own reader, its own punch, its improved printer, and its own disc random access storage unit; and

.7 Honeywell has never had its own drum storage equipment, did not come out with a printer which was satisfactory to its customers until February of 1965, did not produce its own card reader until May of 1965, did not produce its own card punch until mid-1966, and did not produce its own disc random access storage unit until 1969.

15.40.108 Had Honeywell had access in 1957 to the technology shared between IBM and SR, Honeywell could have designed and manufactured a set of its own peripherals for inclusion with the first H–800 system delivery in 1960; later access would have saved money but not alleviated the problem of the 1960s.

15.40.109 That set of Honeywell peripherals would have included a card reader, a card punch, a drum storage device, a disc random access storage device, and a high speed printer with print quality and speed equal to that of SR's high speed printer.

15.40.110 Had Honeywell had access in 1956–1957 to the information exchanged, the first H–800 system could have been in volume production by July 1, 1960.

15.40.111 Delivery of the H–800 with its own set of Honeywell-built peripherals at an earlier date would have enhanced the image of the system in the marketplace and improved the reliability and performance of the complete package.

15.40.112 Had Honeywell had access to the shared technology in 1956–57, first delivery and volume production of the H–400 would have been stepped up to July 1, 1961, resulting in a time saving of six months in first delivery and a full year in volume production over the actual schedule, again with additional competitive advantage of greater dimension.

15.40.113 Assuming Honeywell had had access to the shared technology in 1956–57, the H–400 which had acceptance problems in the marektplace, would have had its image enhanced and its reliability and performance improved because of the availability of a complete set of high quality Honeywell-built peripherals.

15.40.114 Had Honeywell had access to the shared technology, in 1956–57, the H–200 would have been first delivered and in volume production by late 1963, instead of 1964, resulting in a time saving of six months in first delivery and a full year in volume production; this six month to one year advantage would have greatly increased sales of the H–200 system since SR's co-conspirator IBM had problems in meeting promised delivery schedules of its own 360 system as late as 1965 and 1966 which promises were forcedly announced to meet the H–200 system.

15.40.115 The experience of having designed and built a complete set of Honeywell peripherals on the shared technology base for the H–800 and the H–400 systems would have meant that Honeywell's H–200 system would have contained an attractive set of Honeywell-built peripheral devices which would have enhanced the H–200's market image for reliability and performance for customers.

15.40.116 As a result, Honeywell would have become a much more efficient organization earlier with a totally competitive EDP system product to offer in the marketplace and thus would have had substantially increased efficiencies, sales, revenues, and profits throughout the period after access to the shared technology.

15.40.117 Had Honeywell had access to the shared technology, it would also have been able to penetrate user markets earlier from which it was excluded by its lack of peripheral equipment capabilities.

15.40.118 These effects are cumulative.

15.40.119 The most important loss to Honeywell was the loss of the opportunity it could have had to advance its image and customer base position in the field and its consequent reduction in revenue and profit during the years following the technological merger of SR and IBM.

15.40.120 The anticompetitive effect of the sharing of technology between SR and IBM was to place Honeywell (and others) in a "re-invention" cycle in competition with both SR and IBM; SR and IBM conspiratorially obtained an advanced and combined base of know-how in 1957 against which Honeywell and the EDP industry had to compete; it enabled SR and IBM to stay two or three years ahead of Honeywell and the Industry which were "re-inventing" the merged technology whereas SR and IBM were able to concentrate on more advanced products or fresh approaches and to keep them in reserve until competition was about to or did announce or introduce similar items to the market.

15.40.121 This never-ending disadvantage continued with Honeywell and the industry still having to "re-invent" what the co-conspirators shared in technology and which provided a base on which they could build.

15.40.122 Finally, the technological merger dampened the need and diminished the reason for SR and IBM to expend as large sums, relatively speaking, for current R & D, thus reducing the total penetration of EDP equipment and systems and keeping total market size smaller and more risky to enter than otherwise would have been the case.

15.40.123 Honeywell, throughout the period 1957 to 1969, made R & D expenditures for design of EDP equipment, some of which would have been unnecessary at some point in time had Honeywell had access to the technology shared between SR and IBM in 1956 or thereafter.

15.40.124 Honeywell EDP Division's financial history for the period 1955 to 1969 demonstrates the heavy expenses and losses which Honeywell incurred in trying to turn the profit corner in the EDP industry dominated by co-conspirators SR and IBM.

15.40.125 Comparing the relationship between R & D productivity statistics for Honeywell against those with access to the merged technology produced injury and probable damage to Honeywell.

15.40.126 Honeywell's wasted or marginally required EDP R & D expenses produced injury and probable damage to Honeywell.

15.40.127 Honeywell's lost EDP business due to defendants' pattern of conduct, including their control of and shared technology, produced injury and probable damage to Honeywell.

15.40.128 Defendant's pattern of conduct, including the technological merger of IBM and SR, imposed and perpetuated the effects of an entry barrier on the EDP industry and artificially depressed the size and rate of growth of the industry and its market, and depressed Honeywell's share therein and produced injury and probable damage to Honeywell.

15.40.129 Hindsight demonstrates that certain of the injury and indicated damage aforesaid were probably provable with reasonable certainty prior to May 26, 1963; certain thereof were not susceptible of proof at all or to such a certainty until a later time.

16. SR-IBM Settlement of Interferences

16.1 Plaintiff claims that the settlement of the interferences violated Sections 1 and 2 in that SR and IBM each knew of the invalidity of the ENIAC and SSEC applications and other patents and applications.

16.2 IBM repeatedly took the position that the ENIAC application was invalid and did file another petition with the Patent Office in 1959.

16.2.1 See 15.24.2, 15.24.13, 15.24.21 and 15.24.30.

16.2.2 The following lists the Patent Office interferences which were settled by IBM and SR pursuant to the 1956 Agreement, the subject, the application number, the filing date, the applications and the SR "EM" file number for each SR application involved in the interferences settled:

Interference No.	Subject of application	Application No.	Date filed	SR applicants	EM No.
86,576	ENIAC	757,158	June 26, 1946	Eckert, Mauchly	EM–6.
86,997	Information storage system.	98,178	June 10, 1949	Eckert	EM–8 Lukoff.
86,998	do	98,178	do	do	Do.
87,203	do	98,178	do	do	Do.
87,230	ENIAC	757,158	June 26, 1946	Eckert, Mauchly	EM–6.
87,231	BINAC	179,782	Aug. 16, 1950	Eckert, et. al	EM–22.
87,388	ENIAC	757,158	June 26, 1946	Eckert, Mauchly	EM–6.
87,779	ENIAC	757,158	do	do	EM–6.
87,872	ENIAC	757,158	do	do	EM–6.
87,957	Magnetic reading device.	253,189	Oct. 25, 1951	Rubens	ERA–30.
88,118	ENIAC	757,158	June 26, 1946	Eckert, Mauchly	EM–6.

16.2.3 In the August 21, 1956 Agreement, IBM reserved the right to proceed with a challenge to the ENIAC patent application on the public use ground.

16.2.4 In 1958, IBM became concerned because it feared that, for antitrust purposes, it might be argued that IBM's 1956 attempt to institute a public use proceeding against the ENIAC patent application was insufficient since the petition had been denied on a procedural matter and not on the merits.

16.2.5 In 1958, IBM was aware that there could be antitrust ramifications if it did not proceed further and that it could charge in a renewed petition that Eckert and Mauchly committed a fraud on the Patent Office by not disclosing public use information to the Office at the time they executed their oaths in 1947.

16.2.6 IBM, with SR's knowledge, never raised the question of the commission of a fraud on the Patent Office by Eckert and Mauchly in its petitions for institution of public use proceedings.

16.2.7 On February 20, 1959, IBM renewed its previously filed petition for the institution of a public use proceeding against the ENIAC application and did not bring out all of the public use information it had nor the information concerning inventive derivations by Mauchly from Atanasoff which was then in IBM's possession.

16.2.8 Furthermore, both parties knew that the Patent Office had a long established policy of refusing to process public use petitions.

16.2.9 IBM had more to lose than to gain by establishing invalidity of the ENIAC patent application once the 1956 cross-license had been executed because IBM knew that once it had agreed to pay $10,000,000, its competitors would be financially burdened by the ENIAC patent application only if it issued; furthermore, IBM knew that any of the claims of its SSEC application common to ENIAC claims would also be invalid and other SSEC claims reading on ENIAC would be similarly invalid.

16.2.10 When IBM renewed its public use petition in 1959, a patent attorney representing SR wrote a letter to Army Ordnance asking that Ordnance not give IBM access to evidence which might establish the fact that ENIAC had been in public use before the critical date; however, no effort was made by IBM to subpoena the records.

16.2.11 The foregoing acts and non-acts are consistent with conspiracy.

16.3 In 1960, the Assistant Commissioner declined to order a hearing on the claim of public use and IBM took no further legal action.

16.3.1 On May 26, 1960, the Commissioner of Patents by Assistant Commissioner Crocker advised IBM and the ENIAC applicants that the IBM petition to institute public use proceedings had been denied on the ground the affidavits and exhibits submitted on behalf of IBM failed to make a prima facie showing that the subject matter of the ENIAC application was in public use or on sale more than one year prior to its filing; thus, the question of public use of the ENIAC was never considered on the merits by the Patent Office.

16.3.2 After the Patent Office denied IBM's petition for institution of a public use proceeding in 1959, IBM made an internal report to state that it had pursued the public use proceeding in good faith even though any direct benefit to IBM to be obtained from the public use proceeding was eliminated and even though IBM and SR knew the Patent Office proceeding was essentially a sham.

16.3.3 IBM and SR were both aware that further appeals were available on the public use issue and that the Patent Office decision not to hold a public use hearing was not binding on the courts; however IBM concluded it could claim

to have leaned over backwards to appear to act in an ethical manner and that nothing further could be expected of it.

16.3.4 IBM made no further formal attack on the validity of the ENIAC patent application or patent despite its possession of evidence of and belief in the invalidity.

[50] 16.4 Settlements are, of course, to be encouraged unless in the process the antitrust laws are violated and the public interest harmed.

16.5 I find no violation of the antitrust laws and find lack of proof as to injury.

16.5.1 On August 21, 1956, IBM and SR entered into an agreement providing interalia, for a non-exclusive patent cross-license in the EDP field.

16.5.2 Also on August 21, 1956, IBM and SR entered into procedural agreements to dispose of eleven outstanding Patent Office interferences between patents and patent applications of the two companies. Six of these interferences and agreements involved the ENIAC patent application and five involved other SR patent applications.

16.5.3 A Honeywell witness characterized these 1956 IBM–SR interference procedure agreements as "very conventional," and Honeywell itself (through Datamatic, which it controlled) later joined in certain of them.

16.5.4 Honeywell has not proven any fraud in connection with the patents and patent applications involved in the eleven IBM–SR procedural interference agreements.

16.5.5 Honeywell has not shown that the 1956 IBM–SR agreements on interference procedures alone constituted an unreasonable restraint on trade or were otherwise improper.

16.5.6 Honeywell has proven no injury to its business or property caused by the 1956 IBM–SR agreements on interference procedure.

16.5.7 Honeywell has not shown that the 1956 IBM–SR agreements on interference procedures provide any grounds for declaring the ENIAC patent, or any other SR patent, invalid or unenforceable.

16.5.8 There was supression of the facts concerning the 1956 IBM–SR interference agreements.

17. 1961 Agreement and SR and BTL

17.1 The 1961 Agreement apparently resolved the issue of priority between Williams and Mauchly and Eckert.

17.1.1 One of the Principal interferences (No. 85,809) in which the ENIAC patent application was involved was with BTL's Williams patent.

17.1.2 That interference began in 1952 over the issue of priority of invention and ended with BTL and SR litigation on the actually academic [to the parties] question of public use of the ENIAC before the late Judge Archie Dawson of the Southern District of New York.

17.1.3 On July 1, 1961, prior to the trial of that litigation, Western Electric Company (acting for the Bell System, including BTL) and SR executed a complete cross-license of all their patents and patent applications which included all EDP patents and applications, of which ENIAC was one.

17.1.4 This Agreement had the effect of disarming BTL's attack on the validity of SR's ENIAC patent application and put BTL in a position in which it had nothing to gain by establishing the invalidity of the ENIAC patent application.

17.1.5 Pursuant to the terms of 1961 SR-Western Electric Agreement, Western Electric received, among many other things, a license under any patent to issue on the ENIAC patent application.

17.1.6 Because SR owned the Eckert and/or Mauchly patent and application rights (including ENIAC), it was able to and did gain access to the Bell System's very substantial patent and application portfolio; and this was done after BTL had first been held to have priority in the Patent Office over what SR later claimed to be the basic computer patent.

17.2 The issue of public use of the ENIAC was submitted to the District Court and incorrectly decided.

17.2.1 See 18.1.1 through 18.1.5.

17.2.2 BTL never pursued the public use issue vigorously in the Southern District of New York case and certainly not after the execution of the July, 1961 cross-lisense Agreement with SR.

17.2.3 At the time when the question of the public use was submitted to Judge Dawson in the Fall of 1961, BTL had no true interest in establishing public use as a defense to the validity or issuance of the ENIAC patent.

17.2.4 On December 18, 1961 in the course of the BTL case, SR was advised that the Los Alamos Laboratory of the A.E.C. was prepared to furnish an official affidavit that the 1945–46 ENIAC work before the critical date was useful, important, solved real problems and was relied upon; SR declined the affidavit as not helpful, did not reveal the A.E.C. offer to BTL or the court and contended to a contrary effect on the record to the court.

17.2.5 BTL's internal memoranda in connection with the lawsuit prove that it desired to complete the public use litigation in the Southern District of New York at the least expense and with the least possible amount of effort; SR was of a like mind as it never mounted a truly effective effort.

17.2.6 BTL and SR submitted their evidence in perfunctory and conclusory affidavits and deposition transcripts.

17.2.7 Most of the volume of the evidence before Judge Dawson did not bear on the public use issue at all but on the priority issue which had previously been eliminated from the case.

17.2.8 On September 6, 1962, Judge Dawson found that the ENIAC machine had not been in public use more than one year prior to filing the ENIAC application and directed the Commissioner of Patents to issue a patent on the ENIAC application.

17.2.9 After this decision, BTL took a "for-the-record" appeal to the Court of Appeals for the Second Circuit which dismissed the appeal because the case had been moot all along by the 1961 execution of the cross-license between Western Electric and SR.

17.2.10 Thus, had the case been correctly decided by the District Court, the ENIAC patent would not have issued and the EDP industry would not have been threatened with its burden or sanction.

17.3 I find no violation of the antitrust laws and find lack of proof as to injury.

17.3.1 Honeywell has not shown that it was injured in its business or property by reason of the 1961 SR-Western Electric Agreement.

17.3.2 Honeywell has not proven that the 1961 SR–Western Electric Agreement was an unreasonable restraint on trade.

17.3.3 Honeywell has not proven that the 1961 SR-Western Electric Agreement, of itself, violated the Sherman Act or injured Honeywell in its business or property.

[51] 17.3.4 Nonexclusive patent cross-licensing in itself may be proper.

18. 1965 Agreement of SR and IBM

18.1 Following the issuance of the ENIAC patent, the question of whether further payments were required under the 1956 Agreement required resolution.

18.1.1 The 1956 Agreement required that IBM pay minimum royalties to SR of $10,000,000 in eight $1,250,000 annual installments; an additional royalty of 1 percent of IBM's EDP manufacturing costs (for infringing equipment) from October 1, 1956 to September 30, 1964, after crediting the $10,000,000 prepaid, was due if the ENIAC patent should issue prior to December 31, 1964.

18.1.2 After the ENIAC patent issued on February 4, 1964, SR served notice on IBM claiming additional royalties due under the 1956 Agreement, and asked IBM to prepare a statement (certified by independent auditors) of additional royalties due as provided by the 1956 Agreement.

18.1.2.1 Subsequent to the issuance of the ENIAC patent in 1964, and SR engaged in a dispute concerning whether IBM owned SR additional royalties under a provision of the 1956 IBM-SR agreement.

18.1.3 On April 24, 1964, J. Birkenstock of IBM furnished SR with a certified "Statement of Additional Royalty Due" which concluded that since IBM's total manufacturing costs from the period October 1, 1956 for all EDP equipment, infringing or not, did not exceed $1,000,000,000 (making 1% of that less than the $10,000,000 fixed royalty), IBM owed no further royalties other than the remaining fixed royalty payment.

18.1.4 On May 1, 1964, C. McTiernan of SR informed IBM that in SR's opinion IBM had not fulfilled its obligation under the 1956 Agreement as regards furnishing a royalty statement; accordingly, SR requested a formal, exact, detailed presentation which would enable it to certify IBM's accounting.

18.1.5 During 1964 and 1965, IBM and SR continued to negotiate in an attempt to arrive at a satisfactory resolution to their controversy; the main points at apparent issue, aside from the validity of the ENIAC patent, were the interpretation of IBM's obligations under the 1956 Agreement, the scope of the ENIAC

patent claims as they related to IBM equipment (which SR claimed covered some TAB machines) and the accounting measures used by IBM to arrive at its manufacturing costs for infringing equipment.

18.2 In 1964 or 1965 IBM was still contending that the ENIAC was invalid for a number of reasons.

18.2.1 At a December 15, 1964 meeting between IBM and SR patent representatives, Charles Walker, outside patent counsel of IBM, contended that if IBM should prevail on any one of four stated positions in a court contest, the ENIAC patent would be declared invalid; the four contentions were:

.1 The ENIAC patent fails with respect to public use;

.2 Even if SR should persuade the Court that use up to a certain time was experimental, the public use was nevertheless more than a year before claims to the system were first introduced;

.3 Although IBM is a licensee, it has the right to construe a patent and the background against which it should be read; and

.4 Certain claims from the ENIAC patent read on the Phelps patent. [See 6.1 through 6.1.7]

18.2.2 At a February 5, 1965 meeting of representatives of SR and IBM, IBM outside counsel again contended that the ENIAC machine had been in public use and that IBM retained the right under the 1956 Agreement to raise the public use defense against the ENIAC patent; IBM also correctly contended that the public interest would be to have an invalid patent declared invalid, and that Judge Dawson in the SR v. BTL case made a clear error in finding experimental instead of public use.

18.2.3 At an August 11, 1965 meeting of SR and IBM representatives, IBM again contended that the ENIAC patent was invalid by reason of public use and the Phelps patent and reiterated the late claiming defense [See 10.1] and IBM's position that the scope of the ENIAC patent should not include input and output units; at this meeting IBM gave SR a report, prepared as a result of earlier meetings with SR, detailing these contentions.

18.3 It had, however, in 1959 or 1960 given up its strongest argument on invalidity because of public use.

18.3.1 See 16.2.1 through 16.2.10 and 16.3.1 through 16.3.4.

18.4 The dispute resolved into an accounting issue and IBM agreed to further payment of $1,100,000.

18.4.1 See 18 through 18.1.5 and 18.5 through 18.5.4.

18.5 This payment was conditioned by the 1956 agreement on the issuance of the ENIAC application, and it appears that much of the total $11,100,000 paid by IBM to SR represented ENIAC royalties.

18.5.1 The 1956 Agreement contains a specific definition of the ENIAC application and also provides specifically and separately for an additional royalty to be paid in the event ENIAC finally ripened into a patent; the ENIAC application was a significant issue, was negotiated separately from the other issues, was eventually settled separately from the other issues and was the subject of a specific provision in the 1956 Agreement and again in the 1965 renewal or extension agreement.

18.5.2 The 1956 Agreement called for IBM to pay minimum royalties to SR of $10,000,000 plus an additional royalty of 1% of IBM's EDP manufacturing costs (for infringing equipment) from October 1, 1956 to September 30, 1964, after crediting the $10,000,000, if the ENIAC patent should issue prior to December 31, 1964.

18.5.3 Under the 1956 Agreement no additional royalties were payable by IBM if the ENIAC patent did not issue or was invalidated or held unenforceable.

18.5.4 On November 15, 1965, SR and IBM entered into a complete cross-license on all information handling systems patents and patent applications filed between that date and November 15, 1970 and agreed that IBM should pay SR $1,100,000 to settle the dispute over additional royalty due because of the issuance of the ENIAC patent; this accomplished "peaceful co-existence" between the co-conspirators for five more years, each being free to infringe each others' patents without risk.

18.5.4.1 After more than a year's negotiation, IBM and SR on November 15, 1965 reached an agreement resolving, among other things, the dispute concerning the 1956 IBM–SR Agreement.

18.5.4.2 Under the provisions of their 1965 Agreement IBM and SR exchanged paid-up nonexclusive cross-licenses in the field of "information handling" under patents and future patent applications filed prior to November 15, 1970. Moreover,

IBM and SR released each other from all claims under the 1956 agreement, and IBM paid SR $1,100,000 upon the execution of the agreement.

18.6 What is difficult to measure is what part in the 1956 agreement the fact of dismissal of the SR antitrust suit against IBM and other factors played.

18.7 IBM was then, and should be now, apprehensive about antitrust lawsuits.

18.7.1 See 15.26.4 through 15.26.30.

18.8 The fact is that plaintiff and the newcomers in the EDP market in 1956, including Burroughs, NCR, RCA and others, should have in 1956 or later sued SR and IBM which then controlled about 95% of the EDP market.

18.8.1 Had such a suit or suits been commenced by filing prior to May 26, 1963, judicial notice may be taken that they could not have resulted in a trial in less than two (2) to four (4) years nor in a decision in less than four (4) to six (6) years after commencement.

18.8.2 Had such a suit or suits been commenced, judicial notice may be taken that evidence of damage in any one year which flowed from non-access to the shared technology would not have been available until after the end of at least that year or one prior thereto and projections as to the future from deprivation in the past would have been subject to vigorous objection as speculative and conjectural even though broad-based injunctive relief could have been awarded as protection for years in the future.

18.8.3 To illustrate, had the lawsuit been filed in 1957 or 1958 and come to trial and decision in 1960 (a most unlikely event), evidence of the technology-shared damage could have been offered for the years 1957, 1958 and 1959 but estimates of any "pour-over" until 1961 or later would have been met with the objection of guesswork even though the plaintiff (Honeywell for instance) was assumed not only to have been granted free access by discovery to see but also the right to use the shared technology by 1960 as a result of a final decree and no appeal.

18.9 I find that regardless of whatever further accommodation of the interests of SR and IBM resulted from the 1965 Agreement, that the agreement did not violate the antitrust laws.

18.9.1 Honeywell has not proven that the 1965 IBM–SR Agreement was an unreasonable restraint on trade.

18.9.2 Nonexclusive patent cross licensing in itself may be proper.

18.9.3 Honeywell has not proven that the 1965 IBM–SR Agreement violated the Sherman Act or injured Honeywell in its business or property.

18.10 Plaintiff has failed to prove injury.

18.10.1 Honeywell has not proven that the 1965 IBM–SR Agreement, in itself, had any effect on Honeywell.

18.10.2 Honeywell has not shown that it was injured in its business or property by reason of the 1965 IBM–SR Agreement.

19. Discriminatory Licensing

19.1 Plaintiff claims a violation of Section 2 because two competitors of SR have been treated differently.

19.2 The SR and IBM agreements of 1956 and 1965 resulted in payments by IBM to SR of $11,100,000.

19.2.1 See 18.5.1 through 18.5.4.

19.2.2 One percent of IBM's EDP equipment manufacturing cost for the period 1957–64 was agreed by SR and IBM to be $11,100,000.

19.3 The ENIAC application was an important factor in the considerations exchanged.

19.3.1 See 15.24, 15.24.2, 15.24.13, 15.24.21, 15.24.25, 15.24.30, 16.2.2., 18.1.2, 18.2.1 through 18.2.3 and 18.5.1 through 18.5.4.

19.3.2 During the course of the 1956 negotiations between IBM and SR, IBM insisted that any overall settlement include a license to IBM under SR's ENIAC patent application.

19.3.3 The 1956 SR–IBM Agreement as consummated included a cross-license on EDP patents and applications filed prior to October 1, 1956. The ENIAC patent application was included in this group.

19.3.4 Under the 1956 IBM–SR Agreement, SR received, among other things, licenses under IBM's tab patents and applications, and also received technical information on all IBM tabulating machines announced or released to production as of October 1, 1956.

19.3.5 SR officials hoped that the 1956 IBM patent licenses and technical information would include patent licenses and technical information on a proposed

IBM World Wide Accounting Machine (WWAM), and it had been estimated that the rights to this WWAM tabulating machine would be worth $20,000,000 to SR.

19.3.6 SR also received pursuant to the 1956 IBM–SR Agreement patent licenses under IBM's EDP patents and applications, as well as EDP technical information, as of October 1, 1956.

19.3.7 Among the patent licenses each party received pursuant to the 1956 IBM–SR Agreement were licenses under the patents or applications that were involved in eleven interferences with SR patents and applications.

19.3.8 Each party also received from the other, pursuant to the 1956 IBM–SR Agreement, a release for past patent infringement, and IBM agreed to dismiss its counterclaim against SR for infringement of 35 patents.

19.3.9. SR also received, pursuant to the 1956 IBM–SR Agreement $10,000,000 from IBM, plus a covenant by IBM to pay an additional royalty under the ENIAC patent, if a patent issued on the ENIAC patent application prior to January 1, 1965. This additional royalty was to be 1% of the manufacturing cost of each EDP machine embodying any invention covered by the claims of the ENIAC patent manufactured by IBM within the United States between October 1, 1956 and October 1, 1964—after deducting the prepaid $10 million as a credit.

19.3.10 Frost, SR's general counsel and its chief negotiator, had asked his patent people in 1956 to give him an estimate of the values of the respective patent positions of IBM and SR but they were unable to do so. Frost concluded that the only premise he could adopt was that the patents were equally balanced in value.

19.3.11 As to the entire noncash package SR received from IBM in 1956, Frost had been advised by UNIVAC personnel that it was worth from $30,000,000 to $40,000,000.

19.3.12 Shortly after the ENIAC patent issued on February 4, 1964, Birkenstock, IBM's chief negotiator, wrote to T. J. Watson, Jr., IBM's chief executive:

"The issuance of the 'ENIAC' patent to Sperry Rand after ten years of litigation makes our $10 million settlement look many times better than we figured it to be in 1956."

19.3.13 After issuance of the ENIAC patent, IBM and SR became involved in a dispute concerning whether IBM owed additional royalties under the 1% provisions of the 1956 IBM–SR Agreement.

19.3.14 After more than a year's negotiation, IBM and SR on November 15, 1965 reached agreement.

19.3.15 Under the provisions of the 1965 IBM–SR Agreement, IBM and SR exchanged paid-up nonexclusive cross-licenses in the field of "information handling" under patents and patent applications filed prior to November 15, 1970. Under the broad definition of "information handling" in the 1965 Agreement, SR received licenses under IBM's electric typewriter patents as well as under EDP and tab patents. IBM and SR also released each other from all claims under the 1956 IBM–SR Agreement, and IBM paid SR $1,100,000 upon the execution of the agreement.

19.3.16 The ENIAC patent issued on February 4, 1964.

19.3.17 On April 8, 1964, SR assigned its rights in the ENIAC patent to ISD, a wholly-owned subsidiary of SR.

19.3.18 In June of 1964, ISD sent out notices of infringement of the ENIAC patent, with an offer to license "on reasonable terms" to various companies, including Honeywell. ISD offered to license these alleged infringers at 1½% of the selling price of equipment covered by the ENIAC patent. Although ISD continued correspondence and discussions with various alleged infringers, no license agreements were concluded.

19.3.19 Some alleged infringers of the ENIAC patents, including Honeywell, insisted on including SR and its patents in the discussions.

19.4 After the issuance of the ENIAC patent, the defendants initially demanded $250,000,000 from plaintiff for royalties.

19.4.1 In a meeting on July 21, 1965, SR informed Honeywell that the ENIAC license royalty rate was 1½% of the net selling price of each Honeywell EDP system sold or leased with no paid up limit; SR later estimated that Honeywell's liability to it under this proposal for the 1964–1981 life of the ENIAC patent would be in excess of $200,000,000.

19.4.1.1 SR and ISD communicated with Honeywell in 1965 and 1966, but negotiations dragged on into 1967.

19.4.2 At a January 26, 1967 meeting, John Dority of SR stated that he had computed a potential liability of Honeywell approximating $250,000,000 using the 1½ percent figure as applied to past and expected future shipments; Honey-

well indicated to SR representatives that this was quite disproportionate to the $10,000,000 asked of IBM under the 1956 cross-license Agreement with IBM.

19.4.2.1 At the urging of John Dority, UNIVAC patent counsel, a meeting was held on January 26, 1967. At that meeting, SR indicated to Honeywell that SR considered its EDP patent portfolio (excluding ISD's ENIAC patent) as more valuable than Honeywell's and that disparity alone should warrant the payment of a 1-½% royalty by Honeywell.

19.4.2.2 Nevertheless, SR and ISD, in the cynically expressed hope of promptly getting the matter resolved, told Honeywell at their January 26, 1967 meeting that, in the context of a cross-license including the ENIAC patent, they would accept a lump-sum settlement of $1,250,000 annually for 15 years, plus a negotiated settlement for past infringement.

19.4.2.3 Honeywell neither accepted the 1967 SR-ISD offer nor made a counter-offer. No license agreement was ever concluded and Honeywell has never paid any royalties to SR or ISD.

19.5 This was later reduced to about $20,000,000.

19.5.1 During the January 1967 meeting, SR indicated to Honeywell that it would accept, in the context of an EDP patent cross-license between Honeywell and SR and ISD, a lump sum settlement with Honeywell paying SR $1,250,000 annually for fifteen years, a total of $18,750,000, plus settlement for past liability.

19.6 Defendants demanded royalties from the other members of the EDP industry.

19.6.1 After issuance of the ENIAC patent on February 4, 1964, defendants systematically demanded royalties for a license under the ENIAC patent at a rate of 1-½ percent of the selling price of the affected equipment from all EDP industry members, including, among others, GE, Burroughs, RCA, NCR, CDC, Philco-Ford and numerous manufacturers of peripheral equipment; a royalty of 1-½ percent of the selling price (in dollars) of equipment sold or leased in the years 1964–1967 by the main-frame manufacturers appears in Column A below and that four year total royalty multiplied by 4.25 produces a 17 year conservatively estimated royalty which appears in Column B as follows:

	A	B
	4 yr. royalty	17-yr. established royalty
General Electric	$5,848,406	$24,855,726
RCA	6,619,317	28,132,097
CDC	9,857,210	41,893,142
NCR	6,364,531	27,049,257
Philco-Ford	420,840	1,788,570
Burroughs	6,044,316	25,688,343
Total	35,154,620	149,407,135

19.6.1.1 Lump-sum settlements in the context of cross-licenses with SR and ISD were offered to those alleged infringers with whom negotiations continued, including RCA and Honeywell, but no license agreements were concluded.

19.6.2 During a July, 1965 meeting with Burroughs, SR indicated that it would consider granting it a paid-up license for $20,000,000.

19.6.3 In December, 1965, SR contacted representatives of GE and indicated that SR was willing to grant GE a paid-up license for $8,500,000.

19.6.4 In January, 1966, GE informed SR that the $8,500,000 paid-up license offered to them was unreasonable and discriminatory since it was similar in total amount to the settlement given to IBM although GE's computer business was much smaller.

19.6.5 At the October, 1966 meeting of SR and RCA, SR was prepared to offer RCA a cross-license at the rate of $1,250,000 per year for 15 years or an aggregate of $18,750,000.

19.6.6 RCA rejected the SR demand as exorbitant.

19.7 A substantial difference is that in 1956 the ENIAC patent was still in the application stage and in 1964 the patent had issued.

19.8 It, of course, strains logic to settle with IBM (one of the two dominant members of the industry in 1956 and the monopolist in 1965 and now) for $11,-

100,000 and to demand in 1964–1967 from plaintiff (a minor factor in the industry) $250,000,000 or $20,000,000.

19.8.1 The competitive situation and comparative patent portfolio values of IBM and SR during the license negotiations in 1956 are comparable to the competitive situation and comparative patent portfolio values of SR and Honeywell during their license negotiations in 1966–67.

19.8.2 In the 1956 negotiations for an EDP cross-license between IBM and SR, SR representatives indicated to IBM representatives that the SR EDP patent and application portfolio, excluding the value of the then pending ENIAC patent application, was equal to the IBM EDP patent and application portfolio.

19.8.3 In negotiations with IBM in 1965, SR contended that the $10,000,000 paid by IBM to SR under the 1956 Agreement was not adequate to cover 1% of IBM's EDP equipment manufacturing cost for the years 1957–64; as a result IBM paid an additional $1,100,000 royalty to SR under the 1965 Agreement.

19.8.4 In answer to Honeywell's Interrogatory 58 in this case, SR stated that none of the $10,000,000 paid by IBM under the 1956 Agreement was attributable to a license under the ENIAC patent rights.

19.8.5 Contemporaneous documents, however, indicate that IBM's license under the ENIAC patent rights was claimed by SR at a value equal to 1% of IBM's EDP equipment manufacturing cost for the years 1957–64; although SR represented in negotiations with Eckert and Mauchly that only 2% of the IBM 1956 Agreement royalty of $10,000,000 [or $200,000] was attributable to the license under the ENIAC patent rights; if this is accepted, the 30A patents and applications account for a larger part of the $10,000,000 than either conspirator admits.

19.8.6 In negotiations between Honeywell and defendants in January 1967, defendants indicated that they regarded Honeywell's EDP patent and application portfolio as equal to defendants' EDP patent and application portfolio excluding the ENIAC patent.

19.8.7 The IBM royalty rate under the ENIAC patent was 1% of EDP system and machine manufacturing cost over the 8 year period 1956–64 compared with the royalty rate demanded from Honeywell and the rest of the EDP industry of 1½% of EDP system and machine selling price or rental value over the 17 year period 1964–81.

19.8.8 Had Honeywell been given the same arrangement as IBM for the same period 1957 through 1964, royalties for access to the ENIAC patent and the rest of the SR portfolio would have totaled merely $953,680 compared with the minimum $20,000,000 demand made by defendants before ISD sued.

19.8.9 Honeywell's royalty based on 1½% of the selling price or rental value of shipments for the four year period immediately following the issuance of the ENIAC patent would have been in excess of $8,000,000 and would greatly increase every year.

19.9 I believe competitors should in fairness be treated somewhat equally but find no violation of the antitrust laws.

19.9.1 Honeywell has not shown that acceptance of defendants' 1967 license offer would have caused a substantial impairment of competition in the relevant market; it would have increased cost or reduced profit on the basis of 1½% of price.

[52] 19.9.2 In order to sustain a finding of patent misuse or a Sherman Act violation based on discriminatory licensing, at least the following must be present: (a) the plaintiff took a license; (b) the royalty rate charged plaintiff and that charged a competitor were unequal; (c) in all particulars relevant to equality of rates plaintiff and its licensed competitor were similarly situated; and (d) the royalties were an important expense factor in the production costs and the discriminatory rate caused substantial impairment of competition in the relevant market.

19.9.3 Honeywell failed to prove that defendants' offers to license the ENIAC patent and SR's EDP patents violated the Sherman Act, injured Honeywell in its business or property, or provide any basis for declaring the ENIAC patent invalid or unenforceable.

[53] 19.9.4 Even if Honeywell had proven any impropriety on defendants' part in making the 1964–67 license offers, any such impropriety would have been cured and purged by the placing of ISD's patent infringement case (and the question of appropriate royalties or infringement damages) before the Court.

19.10 Plaintiff has not proved injury.

19.10.1 Honeywell has not shown that the SR–ISD 1964–67 offers to license their patents injured Honeywell in its business or property.

20. Pending Application Royalties

20.1 After issuance of the ENIAC patent in 1964 and a demand by ISD for royalties, H and SR discussed a possible cross license of their respective patent portfolios.

20.1.1 After the issuance of the ENIAC patent in 1964, Honeywell and SR, at Honeywell's request, discussed a possible cross-license of their EDP patents.

20.1.1.1 In October, 1964, ISD requested a meeting with representatives of Honeywell to discuss a license under the ENIAC patent; there has never been an EDP patent cross-license or know-how exchange between Honeywell and SR.

20.1.1.2 No such patent cross-license ever ensued.

20.1.2 Also in October, 1964, SR sent Honeywell a notice of infringement of two additional SR EDP Patents Nos. 2,625,607 and 2,686,100 (EM Nos. 2 and 2A).

20.1.3 In December, 1964, Honeywell requested a specification of the ENIAC claims believed to apply to Honeywell EDP equipment and indicated that any meetings to discuss licenses under the ENIAC patent would have to be arranged so that both SR and ISD representatives were present.

20.1.4 In May, 1965, SR inquired of Honeywell as to when a meeting with SR and ISD could be arranged but protested that the matters to be considered by Honeywell and SR were entirely separate from the matters to be considered by Honeywell and ISD.

20.1.5 In June, 1965, SR sent Honeywell a notice of infringement of two additional SR EDP Patents Nos. 3,189,290 (EM No. 19A) and 3,189,291.

20.1.6 On July 21, 1965, representatives of SR and ISD asserted that the ENIAC patent claims covered entire data processing systems and submitted to Honeywell a draft of an ENIAC license agreement which provided for a royalty of 1–½% of the net amount of the selling price or rental value of the equipment covered by the ENIAC patent.

20.1.7 The draft license agreement also included a clause under which Honeywell was to agree to admit validity of the ENIAC patent and agree not to question or attack it.

20.1.8 Also during the July, 1965 meeting, SR demanded that Honeywell make an initial royalty payment as a prerequisite to any agreement to account for alleged past infringement of the ENIAC patent and estimated that Honeywell's liability during the life of the patent would be in excess of $200,000,000.

20.1.9 SR also stated at the July meeting that it had studied the issue of excluded coinventors to the ENIAC patent four or five times and that it felt safe on the public use question since it had been litigated successfully.

20.1.10 During the July, 1965 meeting, SR gave Honeywell notices of infringement of two additional SR EDP 30A Patent Nos. 2,629,827 and 2,915,966 (EM Nos. 1 and 55C).

20.1.11 In December, 1965, Honeywell informed ISD that it would only deal with SR on a unified basis regarding all patents of both corporations rather than dealing with ISD alone for rights under the ENIAC patent.

20.1.12 At a later meeting in January, 1967, SR representatives informed Honeywell that SR had evaluated its patent portfolio including the ENIAC patent and concluded SR's portfolio was more valuable than Honeywell's; in view of this, SR demanded a royalty of 1-½% of all EDP sales to enter into a total cross-license including the 30A patents and applications.

20.1.13 During the January, 1967 meeting, SR indicated to Honeywell that it would accept a lump sum settlement with Honeywell paying SR $1,250,000 annually for fifteen years [$18,750,000] plus settlement for past liability.

20.1.14 During the January, 1967 meeting, Honeywell stated its belief that the royalty arrangement between IBM and SR was detrimental to Honeywell which was subject to a license on terms which carried a larger dollar amount than was reported to have been paid by IBM which had a much larger sales base.

20.1.15 Honeywell informed SR that it believed the paid-up license offered by SR put Honeywell at an unfair and arguably unlawful disadvantage vis-a-vis both SR and IBM.

20.1.16 During the January, 1967 meeting, SR informed Honeywell that its royalty position was nonnegotiable and that any further meetings, including meetings between top management, would not be particularly helpful.

20.1.17 On May 26, 1967, ISD sued Honeywell and Honeywell sued SR.

20.1.18 Throughout the license negotiations with Honeywell, SR never indicated that it was willing to grant Honeywell access to any EDP know-how nor did it reveal that IBM and SR had already shared their entire EDP technology.

20.2 Honeywell claims that the demands of SR included pre-issuance royalties for the BINAC and UNIVAC, and claims that such demands constitute further violations of the antitrust laws.

20.3 I find that SR did not make such demands and if made do not violate the antitrust laws.

20.3.1 Honeywell has not proven that SR either specifically demanded or actually received from Honeywell or anyone else any royalties on its pending BINAC and UNIVC I patent applications, or on any other 30A patent applications.

20.4 Plaintiff has not proved injury.

21. Section 7 of the Clayton Act

21.1 Count III of the Amended Complaint of May 1, 1968, charged defendants with a violation of Section 7 because of the 1950 acquisition of the ENIAC application.

21.2 The Court on November 29, 1971, dismissed Count III.

21.3 In asking for injunctive relief under Section 16, plaintiff emphasizes the ENIAC asset acquisition and states that this was the root cause of defendants' ability to dominate the EDP market.

21.3.1 On February 6, 1950, Remington Rand acquired control of Eckert-Mauchly Computer Corporation ("EMCC").

21.3.2 At the time of Remington Rand's 1950 acquisition of EMCC, EMCC was an under-financed company.

21.3.3 At the time of Remington Rand's 1950 EMCC acquisition, the ENIAC patent application was owned of record by Eckert and Mauchly, not EMCC. Remington Rand finally acquired full legal control of the ENIAC patent application on February 13, 1950 when Eckert and Mauchly assigned it to EMCC, then under Remington Rand control.

21.3.4 Prior to February 1950, Remington Rand had been engaged in the tabulating business but not EDP.

21.3.5 Honeywell has proved that there was an EDP line of commerce in 1950.

21.4 Plaintiff makes inconsequential reference to the asset acquisitions from IBM and BTL.

21.5 Plaintiff's specific request is that the ENIAC and 30A patents acquisition be declared unenforceable.

21.6 I find that the acquisition by defendants of the ENIAC and 30A patents did not violate Section 7.

21.6.1 Honeywell has not proven that Remington Rand's 1950 acquisition of the ENIAC patent application might have had the effect of, or had the effect of, substantially lessening competition or tending to create a monopoly in any line of commerce in any section of the country.

21.6.2 Honeywell has not proven that Remington Rand's 1950 acquisition of EMCC might have had the effect of, or had the effect of, substantially lessening competition or tending to create a monopoly in any line of commerce in any section of the country.

21.6.3 Honeywell has not proven that the record transfers of the ENIAC patent or patent application from EMCC to Remington Rand in 1952, from Remington Rand to SR in 1955, and from SR to ISD in 1964, might have had the effect of, or had the effect of, substantially lessening competition or tending to create a monopoly in any line of commerce in any section of the country.

21.6.4 Honeywell has not proven that the 1965 IBM-SR Agreement and the 1961 SR-Western Electric Agreement might have had the effect of, or had the effect of, substantially lessening competition or tending to create a monopoly in any line of commerce in any section of the country.

21.6.5 Section 7 of the Clayton Act prohibits the acquisition of the whole or any part of the stock or assets of another corporation "where in any line of commerce in any section of the country, the effect of such acquisition may be substantially to lessen competition, or to create a monopoly".

21.6.6 Section 7 of the Clayton Act in effect in February 1950 applied to the acquisition of stock not to the acquisition of assets. Accordingly, Remington Rand's February 13, 1950 acquisition of the ENIAC patent application could not have violated Section 7 of the Clayton Act.

21.6.7 Even after its amendment in December 1950 to apply to the acquisition of assets, Section 7 of the Clayton Act has applied only to the acquisition of assets from corporations, not individuals. Since Remington Rand acquired, for record, the ENIAC patent application on February 13, 1950 from Eckert and Mauchly, individuals, that record acquisition could not have violated Section 7 of the Clayton Act.

21.6.8 Honeywell, a private party, has no standing to sue for any alleged violations of Section 7 of the Clayton Act.

21.7 Honeywell has not proven that it has suffered any actual or threatened injury to its business or property as a result of any of the acquisitions or transactions it has challenged under Section 7 of the Clayton Act with the exception of the 1956 SR–IBM Agreement.

22. Statute of Limitations

22.1 *Fraud on Patent Office.* If this Court's findings are reversed on appeal, damages to plaintiff will have accrued after May 26, 1963, and plaintiff will be entitled to recover its attorney's fees and costs trebled.

22.2 *1956 Cross-License and Technical Exchange Agreement.* The cause of action accrued before May 26, 1963, and is barred, and prior to that date non-speculative damages could have been proved.

22.2.1 Certain of Honeywell damages caused by the 1956 IBM–SR Agreement were nonspeculative before May 26, 1963.

22.2.2 Honeywell's May 26, 1967 Complaint did not raise any claims for damages caused by the 1956 IBM–SR Agreement.

22.2.3 Honeywell first raised a claim for damages caused by the 1956 IBM–SR Agreement in early 1970.

22.2.4 Certain Honeywell damages caused by the 1956 IBM–SR Agreement were non-speculative before late 1965.

22.2.5 Honeywell's claim based on the 1956 IBM–SR Agreement is barred by the four-year statute of limitations.

22.3 *1956 Interference Agreement.* The cause of action accrued before May 26, 1963, and is barred by the four-year statute of limitations.

22.4 *1961 Agreement.* The cause of action accrued before May 26, 1963, and is barred by the four-year statute of limitations.

22.5 *1965 Agreement.* The cause of action accrued after May 26, 1963, and is not barred, but plaintiff has not proved any injury.

22.6 *Discriminatory Licensing.* The cause of action accrued after May 26, 1963, and is not barred.

22.7 In view of the invalidity of the ENIAC patent, plaintiff will have suffered no injury or damages.

22.8 *Pre-Issuance Royalties.* The cause of action accrued after May 26, 1963, and is not barred.

22.9 Plaintiff has paid nothing and has suffered no injury or damages.

22.10 *Section* 7. The cause of action accrued before May 26, 1963, and is barred.

22.10.1 Honeywell's claims concerning Remington Rand's 1950 acquisitions of EMCC and the ENIAC patent application are barred by the four-year statute of limitations.

22.10.2 Honeywell's Clayton Act claims concerning the 1956 IBM–SR Agreement and the 1961 SR-Western Electric Agreement are barred by the four-year statute of limitations.

22.11 I find no fraudulent concealment sufficient to toll the statute of limitations.

22.11.1 There was no fraudulent suppression of the facts concerning the 1956 IBM-SR Agreement which is sufficient to toll the statute of limitations as to that violation of the Sherman Act.

23. Infringement of ENIAC

23.1 Assuming that ENIAC is determined to be valid and enforceable, I find that certain Honeywell products infringe various claims of the ENIAC.

23.1.1 Prior to the trial, pursuant to Rule 30(b)(6), F.R.C.P., defendant ISD took the deposition of Honeywell consisting of the testimony of officers and other persons it designated to testify on its behalf with respect to Honeywell products H 201–0, H-201–1, H–201–2, H–121, H–1201, H–2201, H–4201, H–111/121/126, H–800, H–400 and D–1000 and the printed documents describing these products, and

said deposition of Honeywell and its printed descriptive materials were received in the evidence at the trial.

23.1.2 Dr. Walter R. Beam, a witness called by defendant ISD, is an electronics expert who has specialized in electronic digital computers, with extensive experience as an engineer, a University faculty member, and an author. Dr. Beam made an investigation of the Honeywell products H–201–0, H 201–1, H–201–2, H–121, H–1201, H–2201, H–4201; H–111/121/126, H–800, H–400, and D–1000, and considered the printed descriptive documents relating thereto (including the Schrimpf patent No. 3,201,762 containing descriptive matter relating to the D 1000 computer) and the deposition of Honeywell taken pursuant to Rule 30(b)(6). He also made an initial study of the ENIAC patent [but not the "file wrapper" or prior art] in order to determine the relationship between Honeywell's products and the subject matter claimed in the ENIAC patent. He devoted more than 1,000 hours to this study.

23.1.3 Dr. Beam explained the manners in which the apparatus disclosed in the ENIAC patent may be arranged to perform different operations and to solve different types of problems to achieve accurate answers.

23.1.4 One particular arrangement which is disclosed in the ENIAC patent calls for an ENIAC function table to be connected in a way such that a program of sequences takes place. Claims 56 and 57 are directed to the apparatus and combination of elements which make possible the carrying out of such a programming arrangement.

23.1.5 If Claim 56 is valid, it is infringed by each of the following Honeywell products: H–201–0, H–201–1, H–201–2, H–121, H–1201, 2–2201, H–4201, H–111/121/126, H–800, H–400, and D 1000. Each of these products contains the combination of elements required by Claim 56 and the claim applies in the same manner as in the ENIAC patent.

23.1.6 If Claim 57 is valid, it is infringed by each of the following Honeywell products: H–201–0, H–201–1, H–201–2, H–121, H–1201, H–2201, H–4201, H–111/121/126, H–800, H–400, and D–1000. Each of these products contains the combination of elements required by Claim 56 and the claim applies in the same manner as in the ENIAC patent.

23.1.7 Claim 52 covers an arrangement to permit program sequences to be selected alternatively, i.e., an arrangement for branching. In such an arrangement the apparatus disclosed in the ENIAC patent is so connected and programmed as to cause the next program sequence step to be taken from some location in the storage means (function table) which is not sequentially arranged with respect to the previous step.

23.1.8 Im claim 52 is valid, it is infringed by each of the following Honeywell products: H–201–0, H–201–1, H 201–2, H–121, H–1201, H–2201, H–4201, H–111/121/126, H–800, H–400, and D 1000. Each of these products contains the combination of elements called for by Claim 52 and the claim applies in the same manner as in the ENIAC patent. Each of these Honeywell products use this program feature in a substantially similar way and for the same general purpose as the apparatus described in the ENIAC patent.

23.1.9 Claim 55 describes another arrangement for sequencing a computer, and for using a storage means (its function table) for program memory. The operation of such an arrangement in the ENIAC patent is a parallel to that of such Honeywell computers as the H–201–0 computer and H–4201 computer.

23.1.10 If Claim 55 is valid, it is infringed by each of the following Honeywell products: H–201–0, H–201–1, H–201–2, H–121, H–1201, H–2201, H–4201, H–111/121/126, H–800, H–400, and D–1000. Each of these products contains the combination of elements required by Claim 55 and the claim applies in the same manner as in the ENIAC patent.

23.1.11 Any or all of the three function tables of the ENIAC patent can serve as memory means storing data in selectively accessible locations.

23.1.12 Claim 69 relates to a memory used for storing data items with particular means for accessing those data items from the memory.

23.1.13 The accessing of both an ENIAC function table and the Honeywell magnetic core memories is done at electronic speeds, and the selection of a particular location is done at electronic speeds.

23.1.14 If Claim 69 is valid, it is infringed by each of the following Honeywell products: H–201–0, H–201–1, H–201–2, H–121, H–1201, H–2201, H–4201, H–111/121/126, H–800, H–400, and D–1000. Each of these products contains the combination of elements required by Claim 69 and the claim applies in the same manner as in the ENIAC patent.

23.1.15 Claim 65 deals with a memory which has specific means for assessing information in it and for locating that information within it.

23.1.16 If Claim 65 is valid, it is infringed by each of the following Honeywell products: H–201–0, H–201–1, H–201–2, H–121, H–1201, H–2201, H–4201, H–111/121/126, H–800, H–400, and D–1000. Each of these products contains the combination of elements required by Claim 65 and the claim applies in the same manner as in the ENIAC patent.

23.1.17 Claim 75 also relates to a memory device and with respect to both the ENIAC function table memory operation and the Honeywell memory operation the relationship between the action provided and the result accomplished is the same, that is, related data items in closely adjacent storage locations in memory (closely adjacent addresses) are arranged to be accessed with circuitry provided for modifying the address.

23.1.18 If Claim 75 is valid, it is infringed by each of the following Honeywell products: H–201–0, H–201–1, H–201–2, H–121, H–1201, H–2201, H–4201, H–111/121/126, H–800, H–400, and D–1000. Each of these products contains the combination of elements required by Claim 75 and the claim applies in the same manner as in the ENIAC patent.

23.1.19 Claim 78 also relates to a data storing means and the configuration for accessing data from it in particular ways.

23.1.20 If Claim 78 is valid, it is infringed by each of the following Honeywell products: H–201–0, H–201–1, H–201–2, H–121, H–1201, H–2201, H–4201, H–111/121/126, H–800, H–400, and D–1000. Each of these products contains the combination of elements required by Claim 78 and the claim applies in the same manner as in the ENIAC patent.

23.1.21 Claim 109 relates to the selection of alternative program sequences upon the comparison of two quantities such that, based on some characteristics of the quantities, a choice of a subsequent operation can be made. This claim applies to a compare operation in the ENIAC patent and in the Honeywell equipment and also applies to a sign comparison operation in the ENIAC patent and in the Honeywell equipment.

23.1.22 If Claim 109 is valid, it is infringed by each of the following Honeywell products: H–201–0, H–201–1, H–201–2, H–121, H–1201, H–2201, H–4201, H–111/121/126, H–800, H–400, and D–1000. Each of these products contains the combination of elements required by Claim 109 and the claim applies in the same manner as in the ENIAC patent.

23.1.23 Claim 142 relates to a particular type of timing mechanism for a data processing machine. Both the Honeywell products H–201–0, H–201–1, H–201–2, H–121, H–2201, and D–1000 and the apparatus in the ENIAC patent have similar circuits used for the timing of the computer and each of them has as its purpose the production of pulses of accurately determined duration at an accurately known frequency, which is related as a submultiple of the source frequency.

23.1.24 If Claim 142 is valid, it is infringed by each of the following Honeywell products: H–201–0, H–201–1, H–201–2, H–121, H–2201, and D–1000. Each of these products contains the combination of elements required by Claim 142 and the claim applies in the same manner as in the ENIAC patent.

23.1.25 Claim 36 relates to a combination of elements for the interruption of the apparatus which controls the sequencing of a computer whereby its operations may be stepped manually at a slow rate through steps it would ordinarily step though at electronic speeds.

23.1.26 The apparatus described in the ENIAC patent to which Claim 36 is applicable includes the cycling unit which can be halted and caused to advance manually.

23.1.27 If Claim 36 is valid, it is infringed by each of the following Honeywell products: H–201–0, H–201–1, H–201–2, H–121, H–1201, H–2201, H–4201, H–111/121/126, and D–1000. Each of these products contains the combination of elements required by Claim 36 and the claim applies in the same manner as in the ENIAC patent.

23.1.28 Claim 122 also relates to the facility for manually advancing the operations of the computer and additionally requires certain display means.

23.1.29 If Claim 122 is valid it is infringed by each of the following Honeywell products: H–201–0, H–201–1, H–201–2, H–121, H–1201, H–2201, H–4201, and H–111/121/126. Each of these products contains the combination of elements called for by Claim 122 and the claim applies in the same manner as in the ENIAC patent.

23.1.30 Claim 8 relates to an electronic computing system in which a control system of pulses is used to manipulate numbers in a series of units constructed for that purpose and some of which are constructed to do arithmetic operations.

23.1.31 Claim 8 was ENIAC patent application Claim 39 and was in Interference 85,809 in the U.S. Patent Office [in which the Patent Office held Williams had priority on his 1942 invention] and in litigation [but not on any issue of priority] in Sperry Rand Corp. v. Bell Telephone Labs, Inc., 208 F. Supp. 598, 135 USPQ 254 (S.D.N.Y. 1962), appeal dismissed [as mooted by settlement] 317 F.2d 491, 137 USPQ 497 (2d Cir. 1963).

23.1.32 If Claim 8 is valid, it is infringed by each of the following Honeywell products: H–201–0, H–201–1, H–201–2, H–121, H–1201, H–2201, H–4201 and H–111/121/126. Each of these products contains the combination of elements required by Claim 8 and the claim applies in the same manner as in the ENIAC patent.

23.1.33 Claim 9 is similar to Claim 8, except that among other distinctions Claim 9 calls for a multiplicity of arithmetic units and the requirement to emit pulse signals significant of the numerical result of respective arithmetic operations.

23.1.34 If Claim 9 is valid, it is infringed by each of the following Honeywell products: H–201–2 and H–4201. Each of these products contains the combination of elements required by Claim 9 and the claim applies in the same manner as in the ENIAC patent.

23.1.35 Claim 83 of the ENIAC patent pertains to the provision of a reservoir for input data and output data so arranged and connected as to permit a very much slower inputting device to operate effectively with a very much faster processor by collecting the input data in a temporary storage means before processing it and placing the data to the output in a second temporary storage means prior to transferring it at a slow rate of speed (as compared to electronic speeds) to an output device. Both the apparatus described in the ENIAC patent and Honeywell products H–201–0, H–201–1, H–201–2, H–121, H–1201, H–2201, H–4201, H–111/121/126, –800, H–400, and D–1000 provide the samae function in this respect.

23.1.36 If Claim 83 is valid, it is infringed by each of the following Honeywell products: H–201–0, H–201–1, H–201–2, H–121, H–1201, H–2201, H–4201, H–111/121/26. H–800, H–400, and D–1000. Each of these products contains the combination of elements required by Claim 83 and the claim applies in the same manner as in the ENIAC patent.

23.1.37 Claim 86 relates to another aspect of input operation described in the ENIAC patent and to a similar or parallel operation in the Honeywell systems. Specifically it relates to the ability to perform data processing operations simultaneously with the transmission of data from an input device and the ability to condition continuation of additional data processing operations on the completion of the input operation and the completion of the concurrent data processing operation. Both the apparatus described in the ENIAC patent and Honeywell equipment H–201–0, H–201–1, H–201–2, H–121, H–1201, H–2201, H–4201, H–111/121/26, H–800, H–400, and D–1000 perform the same function.

23.1.38 If Claim 86 is valid, it is infringed by each of the following Honeywell products. H–201–0, H–201–1, H–201–2, H–121, H–1201, H–2201, H–4201, H–111/122/126, H–800, H–400, and D–1000. Each of these products contains the combination of elements required by Claim 86 and the claim applies in the same manner as in the ENIAC patent.

23.1.39 Claim 88 pertains to a data processing machine having a capacity for synchronization of data transfer operations between a device with a timer operating at one rate and a second device with a timer operating at a second rate.

23.1.40 If Claim 88 is valid, it is infringed by each of the following Honeywell products: H–201–0, H–201–1, H–201–2, H–121, H–1201, H–2201, H–4201, H–111/121/126, H–800, H–400, and D–1000. Each of these products contains the combination of elements required by Claim 88 and the claim applies in the same manner as in the ENIAC patent.

23.1.41 With respect to each of Claims 8, 9, 36, 52, 55, 56, 57, 65, 69, 75, 78, 83, 86, 88, 109, 122 and 142, the specified combination of elements finds response in a combination of elements in each Honeywell product which infringes such claims; providing that the definition of the term "pulse" is that stated in the 1963 Amendment; thereby, the combination of elements in each infringing Honeywell

product cooperates in the same general way and for the same general purpose as that described in the ENIAC patent.

23.1.42 The meaning of the words of the 17 claims of the ENIAC patent in suit is the same as applied both to the apparatus of the ENIAC patent and the accused Honeywell equipment.

23.1.43 During the trial, Honeywell adduced no evidence controverting the clear evidence of infringement.

[54] 23.1.44 In determining whether an accused device infringes a valid patent, resort must be had in the first instance to the words of the claim. If the accused matter falls clearly within the claim, infringement is made out and that is the end of it.

23.1.45 If any of the seventeen claims of the ENIAC patent in suit is valid, ISD is entitled to an injunction against continued infringement by Honeywell of any such claim.

24. Damages

24.1 Neither plaintiff nor defendants are entitled to any damages except as follows:

24.2 If it is later determined that plaintiff has proved fraud on the Patent Office, plaintiff will be permitted to establish that part of its attorneys' fees and costs attributable to its antitrust claim.

24.3 If it is later determined that defendants have violated the antitrust laws, plaintiff will be permitted to establish the damage to its business or property where damages can be proved within the limitation period.

24.4 If it is later determined that the ENIAC patent is valid and enforceable and infringed, defendants will be permitted to establish their infringement damages.

24.5 I do not believe this to be an exceptional case and do not believe that reasonable attorneys' fees should be awarded to the prevailing party in the patent part of this litigation.

24.6 If it is decided on appeal or on remand that this is an exceptional case, reasonable attorneys' fees will be awarded to the prevailing party.

25. Declaratory and Injunctive Relief

25.1 I find that the ENIAC is invalid and unenforceable and that plaintiff is entitled to a declaration to that effect.

25.2 I find that plaintiff is entitled to an injunction restraining defendants from enforcing or attempting to enforce the monopoly created by the invalid ENIAC patent.

25.3 I find that if the ENIAC is later declared valid, that defendants are entitled to an injunction against continued infringement by plaintiff.

26. Order for Judgment

26.1 The clerk shall enter judgment forthwith on these findings and conclusions as follows:

26.1.1 The ENIAC patent, U.S. Patent Serial No. 3,120,606 of Illinois Scientific Developments, Inc ("ISD") is hereby declared to be invalid and unenforceable. The counterclaim of ISD against Honeywell is dismissed.

26.1.2 Defendants and each of them and their respective officers, agents, servants, employees and all persons in active concert or participation with them or either of them who receive actual notice of this judgment by personal service or otherwise be and they hereby are permanently restrained and enjoined, pending further order, from enforcing or attempting to enforce the invalid ENIAC patent aforesaid against Honeywell, its subsidiaries, successors, privies or aquired mediately or immediately from Honeywell.

26.1.3 For the defendant Sperry Rand Corporation and against plaintiff Honeywell Inc., on Counts 1 and III of plaintiff's Second Amended Complaint.

26.1.4 Neither plaintiff nor defendants are entitled to an award of costs.

APPENDIX

1. Public Use

1.1.1.11, 35 U.S.C 102(b).

2. On Sale

2.1.1, 35 U.S.C. § 102(b).
2.1.2, 35 U.S.C. § 102(b).
2.1.8, 35 U.S.C. § 102(b).

3. Atanasoff

3.1.2, 35 U.S.C. § 102(f).

4. Inventors

4.3.22, 35 U.S.C. Section 282; RCA v. Radio Engineering Labs., Inc., 293 U.S. 1, 8, 21 USPQ 353, 355–356 (1934).

4.3.23, RCA v. Radio Engineering Labs., Inc., 293 U.S. 1, 8, 21 USPQ 353, 355–356 (1934); Acme Highway Products Corp. v. D. S. Brown Co., 431 F.2d 1074, 1083, 167 USPQ 129, 135–136 (6th Cir. 1970).

4.3.25, 35 U.S.C. Section 282; see Leeds & Catlin v. Victor Talking Machine Co., 213 U.S. 301, 319 (1909).

4.3.26, Agawam Co. v. Jordan, 74 U.S. (7 Wall.) 583 (1868); Hobbs v. United States Atomic Energy Comm., 451 F.2d 849, 864–65, 171 USPQ 713, 723–725 (5th Cir. 1971).

4.3.28, The Telephones Cases, 126 U.S. 1, 561–63 (1888); Larson v. Crowther, 26 F.2d 780, 788–89 (8th Cir. 1828).

7. First Draft Report

7.1.2.3, 35 U.S.C. § 102(b).

8. AMP Report and Burks Article

8.2.5, Griswold v. Oil Capital Valve Co., 375 F.2d 532, 537, 152 USPQ 95, 97–98 (10th Cir. 1966); McCullough Tool Co. v. Well Surveys, Inc., 343 F.2d 381, 398, 145 USPQ 6, 19–20 (10th Cir. 1965), cert. denied, 383 U.S. 933, 148 USPQ 772 (1966); Greening Nursery Co. v. J and R Tool and Mfg. Co., 376 F.2d 738, 740, 153 USPQ 660, 661–662 (8th Cir. 1967); 35 U.S.C. Section 103.

8.2.6, Griswold v. Oil Capital Valve Co., 375 F.2d 532, 537, 152 USPQ 95, 97–98 (10th Cir. 1966); McCullough Tool Co. v. Well Surveys, Inc., 343 F.2d 381, 398, 145 USPQ 6, 19–20 (10th Cir. 1965), cert. denied, 383 U.S. 933, 148 USPQ 772 (1966); Greening Nursery Co. v. J and R Tool and Mfg. Co., 376 F.2d 738, 740, 153 USPQ 660, 661–662 (8th Cir. 1967); 35 U.S.C. Section 103.

9. Description

9.1.2, U.S.C. Section 112 (see Manual of Patent Examining Procedure Section 702); Eversharp, Inc. v. Fisher Pen Co., Inc., 204 F.Supp. 649, 671–72, 132 USPQ 423, 440–441 (N.D. Ill. 1961); 35 U.S.C. Section 282.

9.1.4, Kesling v. General Motors Corp., 66 F.Supp. 1, 6, 70 USPQ 485, 489 (E.D. Mo. 1946), aff'd, 164 F.2d 824, 76 USPQ 30 (1947); Suczek v. General Motors Corp., 35 F.Supp 806, 809, 47 USPQ 376, 379–380 (E.D. Mich. 1940), aff'd, 132 F.2d 371, 56 USPQ 45 (6th Cir. 1942); Bowser, Inc. v. United States, 388 F.2d 346, 349 (Ct. Cl. 1967).

10. Pulse

10.1.7.1, Webster Electric Co. v. Splitdorf Electrical Co., 264 U.S. 463, 465 (1924); Muncie Gear Works, Inc. v. Outboard Marine & Mfg. Co., 315 U.S. 759, 768, 53 USPQ 1, 5 (1942).

10.1.7.2, Standard Oil Development Co. v. James B. Berry Sons Co., 92 F.2d 386, 388, 35 USPQ 102, 104–105 (3rd Cir. 1937); General Foods Corp. v. Perk

Foods Co., 419 F.2d 944, 948–949, 164 USPQ 1, 3–4 (7th Cir. 1969), cert. denied, 397 U.S. 1038, 165 USPQ 290 (1970).

10.1.7.3, Webster Electric Co. v. Splitdorf Electrical Co., 264 U.S. 463 (1924); General Foods Corp. v. Perk Foods Co., 419 F.2d 944, 164 USPQ 1 (7th Cir. 1969), cert. denied, 397 U.S. 1038, 165 USPQ 290 (1970).

10.1.7.4, Schriber-Schroth Co. v. Cleveland Trust Co., 305 U.S. 47, 39 USPQ 242 (1938); Webster Electric Co. v. Splitdorf Electrical Co., 264 U.S. 463, 465 (1924); General Foods Corp. v. Perk Foods Co., 419 F.2d 944, 164 USPQ 1 (7th Cir. 1969), cert, denied, 397 U.S. 1038, 165 USPQ 290 (1970).

10.1.7.5, Schriber-Schroth Co. v. Cleveland Trust Co., 305 U.S. 47, 39 USPQ 242 (1938); Chicago Pneumatic Tool Co. v. Hughes Tool Co., 192 F.2d 620, 91 USPQ 277 (10th Cir. 1951).

10.1.7.6, Railway Co. v. Sayles, 97 U.S. 554, 563 (1878); Tropic-Aire, Inc. v. Sears, Roebuck & Co., 44 F.2d 580, USPQ 301 (8th Cir. 1930), cert. denied, 282 U.S. 904 (1931); Pratt and Whitney Co. v. United States, 345 F.2d 838, 843, 145 USPQ 429, (Ct. Cl. 1965).

11. Delay

11.5.9, Sperry Rand Corp. v. Bell Telephone Labs, 208 F.Supp. 598, 135 USPQ 254 (S.D. N.Y. 1962).

11.7, Woodbridge v. United States, 263 U.S. 50 (1923).

11.7.1, Woodbridge v. United States, 263 U.S. 50 (1923).

11.7.2, Lowry v. Allen, 203 U.S. 476 (1906).

11.12.1, Sperry Rand Corp. v. Bell Telephone Labs., Inc., 208 F. Supp. 598, 600, 601, 135 USPQ 254, 256 (S.D. N.Y. 1962).

11.13.1.3, 35 U.S.C. Section 151.

11.14.4, Overland Motor Co. v. Packard Motor Co., 274 U.S. 417, 425 (1927).

11.14.5, Overland Motor Co. v. Packard Motor Co., 274 U.S. 417 (1927); Columbia Motor Car Co. v. C. A. Duerr & Co., 184 F. 893 (2d Cir. 1911); Hartford-Empire Co. v. Obear-Nester Glass Co., 39 F.2d 769, 775, 4 USPQ 483, 488–489 (8th Cir. 1930); Ericson et al. v. Jorgensen et al., 180 F.2d 180, 181, 183, 84 USPQ 176, 178–179 (D.C. Cir. 1950); Cline Electric Mfg. Co. v. Kohler, 27 F.2d 638, 641–42 (7th Cir. 1928).

12. Validity

12.1.1, 35 U.S.C. § 282.

12.1.1.1, Aero Spark Plug Co. v. B. G. Corporation, 130 F.2d 290, 294, 54 USPQ 348, 351–352 (2d Cir. 1942).

12.1.1.2, Radio Corporation of America v. Radio Engineering Laboratories, Inc., 293 U.S. 1, 21 USPQ 353 (1934); Cleveland Punch & Shear Works Co. v. E. W. Bliss Co., 145 F.2d 991, 64 USPQ 77 (6th Cir. 1944), noting: Cuno Engineering Corp. v. Automatic Devices Corp., 314 U.S. 84, 51 USPQ 272 (1941).

12.1.1.3, Frank Adam Electric Co. v. Colt's Patent Fire Arms Mfg. Co., 148 F.2d 497, 65 USPQ 85 (8th Cir. 1945), citing: Muncie Gear Works, Inc. v. Outboard Marine & Mfg. Co., 315 U.S. 759, 768, 53 USPQ 1, 5 (1942).

12.1.1.4, American Infra-Red Radiant Co. v. Lambert Industries, 360 F.2d 977, 149 USPQ 722 (8th Cir. 1966); Butler Manufacturing Company v. Enterprise Cleaning Company, 81 F.2d 711, 28 USPQ 196 (8th Cir. 1936); Buchanan et al. v. The Wyeth Hardware & Manufacturing Company, 47 F.2d 704, 8 USPQ 389 (8th Cir. 1931); John Deere Co. of Kansas City v. Graham, 333 F.2d 529, 142 USPQ 459 (8th Cir. 1964); rev. on other grounds at 383 U.S. 1, 148 USPQ 459; Piel Mfg. Co., Inc. v. George A. Rolfes Co., 363 F.2d 57, 150 USPQ 330 (8th Cir. 1966).
Cir. 1966); Butler Manufacturing Company v. Enterprise Cleaning Company, 81

12.1.1.5, Corning Glass Works v. Anchor Hocking Glass Corp., 253 F. Supp, 461, 149 USPQ 99 (D. Del. 1966); Huston v. Buckeye Bait Corp., 237 F.2d 920, 112 USPQ 4 (6th Cir. 1956).

12.1.1.6, Graham Paper Company v. International Paper Company, 46 F.2d 881, 8 USPQ 463 (8th Cir. 1931); Hearings Before the Subcommittee on Antitrust and Monopoly of the Committee on the Judiciary, United States Senate, Eighty-Seventh Congress, Pursuant to S. Res. 52 on S. 1552, October-November, 1961; Hearings Before the Antitrust Subcommittee of the Judiciary, House of Representatives, Eighty-Seventh Congress, on H.R. 6245, May 1962; "1961–1962 Management Survey of the U.S. Patent Office," Study Prepared for the Subcommittee on Patents, Trademarks, and Copyrights of the Committee on the Judiciary, United States Senate, Eighty-Seventh Congress, Pursuant to S. Res. 267; "To Promote the Progress of * * * Useful Arts in an Age of Exploding Technology", Report of the President's Commission on the Patent System, 1966; Special Com-

mittee to Study the Patent System, Final Report, July 14, 1966, American Patent Law Association.

12.1.1.7, Atlas Copco Aktieoblag v. Ingersoll-Rand Co., 155 USPQ 651 (D. N.J., 1967); Graham v. John Deere Co., 383 U.S. 1, 18, 148 USPQ 459, 467 (1966); A. & P. Tea Co. v. Supermarket Co., 340 U.S. 147, 156, 87 USPQ 303, 307–308 (1950); Packwood v. Briggs & Stratton Corp., 195 F.2d 971, 974, 93 USPQ 274, 276 (3rd Cir. 1952).

12.2.3.1, 35 U.S.C. § 102(b) (1952); Pennock v. Dialogue, 27 U.S. (2 Pet.) 1 (1829); Munice Gear Works, Inc. v. Outboard Marine & Mfg. Co., 315 U.S. 759, 53 USPQ 1 (1942); Electric Storage Battery Co. v. Shimadzu, 307 U.S. 5, 41 USPQ 155 (1939).

12.2.3.2, Metallizing Eng'r Co. v. Kenyon Bearing Auto Parts Co., 153 F.2d 516, 520, 68 USPQ 54, 58 (2d Cir. 1946); Andrews v. Hovey, 123 U.S. 267 (1887); Cataphote Corp. v. De Soto Chemical Coatings, Inc., 356 F.2d 24, 148 USPQ 527 (9th Cir. 1966).

12.2.3.3, Hall v. Macneale, 107 U.S. 90, 97 (1882); Root v. Third Ave. R.R., 146 U.S. 210 (1892); Egbert v. Lippman, 104 U.S. (14 Otto.) 333, 336 (1881); Watson v. Allen, 254 F.2d 342, 345, 117 USPQ 68, 69–70 (D.C. Cir. 1958).

12.2.3.4, Elizabeth v. Pavement Co., 97 U.S. 126 (1877).

12.2.3.5, Smith & Griggs Mfg. Co. v. Sprague, 123 U.S. 249 (1887); Monolith Portland Midwest Co. v. Kaiser Aluminum & Chemical Corp., 267 F. Supp. 726, 152 USPQ 380 (S.D. Cal. 1966), modified, 407 F.2d 288, 160 USPQ 577 (9th Cir. 1969); Bourne v. Jones, 114 F. Supp. 413, 98 USPQ 206 (S.D. Fla. 1951), aff'd, 207 F.2d 173, 98 USPQ 205 (5th Cir.), cert. denied, 346 U.S. 897, 99 USPQ 490 (1953).

12.2.3.6, Magnetics, Inc. v. Arnold Eng'r Co., 438 F.2d 72, 168 USPQ 392, 394 (7th Cir. 1971); Monolith Portland Midwest Co. v. Kaiser Aluminum & Chem. Corp,. 267 F. Supp. 726, 785, 152 USPQ 380, 427–428 (S.D. Cal. 1966), aff'd, 407 F.2d 288, 160 USPQ 577 (9th Cir. 1969).

12.2.3.7, Nicholson v. Carl W. Mullis Eng'r & Mfg. Co., 315 F.2d 532, 137 USPQ 13 (4th Cir. 1963).

12.2.3.8, Atlas v. Eastern Air Lines, Inc., 311 F.2d 156, 136 USPQ 4 (1st Cir. 1962), cert. denied, 373 U.S. 904, 137 USPQ 912 (1963).

12.2.3.9, Smith & Griggs Mfg. Co. v. Sprague, 123 U.S. 249, 267 (1887); Buser v. Novelty Tufting Machine Co., 151 F. 478 (6th Cir. 1907); Thomson-Houston Electric Co. v. Lorain Steel Co., 117 F. 249 (2d Cir. 1902); W-R Co. v. Sova, 106 F.2d 478, 481, 43 USPQ 35, 37–38 (6th Cir. 1939).

12.2.3.10, Koehring Co. v. National Automatic Tool Co., 362 F.2d 100, 149 USPQ 887 (7th Cir. 1966).

12.2.3.11, Smith & Griggs Mfg. Co. v. Sprague, 123 U.S. 249 (1887); Coffin v. Ogden, 85 U.S. (18 Wall) 120 (1873); National Biscuit Co. v. Crown Baking Co., 105 F.2d 422, 427, 42 USPQ 214, 218–219, (1st Cir. 1939).

12.2.3.12, Egbert v. Lippmann 104 U.S. (14 Otto.) 333 (1881); Atlas v. Eastern Air Lines, Inc., 311 F. 2d 156, 159, 136 USPQ 4, 6 (Cir. 1962), cert. denied, 373 U.S. 904, 137 USPQ 912 (1963).

12.2.3..13, Atlas v. Eastern Air Lines, Inc., 311 F. 2d 156, 136 USPQ 4 (1st Cir. 1962), cert. denied, 373 U.S. 904, 137 USPQ 912 (1963); Koehring Co. v. National Automatic Tool Co., 362 F. 2d 100, 149 USPQ 887 (7th Cir. 1966).

12.2.3.14, Midland Flour Co. v. Bobbitt, 70 F. 2d. 416, 21 USPQ 60, (8th Cir. 1934); Franz Manufacturing Co. v. Phenix Mfg. Co., 307 F. Supp. 822, 824, 164 USPQ 381, 382–383 (E.D. Wis. 1970); Tri-Wall Containers, Inc. 1. United States, 408 F. 2d 748, 750, 161 USPQ 116, 118 (Ct. Cl.), cert. denied, 396 U.S. 828, 163 USPQ 704 (1969).

12.2.4.1, 35 U.S.C. § 102(b).

12.2.4.2, Amphenol Corp. v. General Time Corp., 397 F. 2d 431, 433, 158 USPQ 113, 114 (7th Cir. 1968); Magee v. Coca-Cola Co. 232 F. 2d 596, 109 USPQ 124 (7th Cir. 1956).

12.2.4.3, Sterns-Roger Mfg. Co. v. Ruth, 179 F. Supp. 906, 124 USPQ 3 (D. Colo. 1959), Philco Corp. v. Admiral Corp., 199 F. Supp. 797, 131 USPQ 413 (D. Del. 1961).

12.2.4.4, Chicopee Mfg. Corp. v. Columbus Fiber Mills Co., 165 F. Supp. 307, 118 USPQ 53 (M.D. Ga. 1958).

12.2.4.5, Mayer v. A. & H. G. Mutschler, 248 F. 911, 915 (2nd Cir.), (cert. denied, 248 U.S. 563 (1918); Monroe v. Bresee, 239 F. 727 (7th Cir. 1917).

12.2.4.6, Piet v. United States, 176 F. Supp. 576, 123 USPQ 21 (S.D. Cal. 1959), modified, 283 F. 2d 693, 127 USPQ 410 (9th Cir. 1960); In re Hobbs, 165 USPQ 99, 132 (A.E.C. Pat. Comp. Bd., 1970); 42 U.S.C. § 2185 (1965).

12.2.4.7, A. H. Emery Co. v. Marcan Products Corp., 268 F. Supp. 289, 153 USPQ 337 (S.D. N.Y. 1967); Cloud v. Standard Packaging Corp., 376 F. 2d 384, 153 USPQ 317 (7th Cir. 1967).

12.2.5.1, 35 U.S.C. §§ 111 and 115.

12.2.5.2, Kennedy v. Hazelton, 128 U.S. 667 (1888).

12.2.5.3, Interstate Bakeries v. General Baking Co., 84 F. Supp. 92, 113, 80 USPQ 566, 583–584 (D. Kan. 1948).

12.2.5.4, Corona Cord Tire Co. v. Dovan Chemical Corp., 276 U.S. 358 (1928); Pennington v. National Supply Co., 95 F. 2d 291, 37 USPQ 18 (5th Cir. 1938); Monroe Auto Equipment Co. v. Heckethorn Mfg. & Supply Co., 332 F. 2d 406, 141 USPQ 549 (6th Cir.), cert. denied, 379 U.S. 888; 143 USPQ 465 (1964).

12.2.6.1, 35 U.S.C. § 102(a), (b).

12.2.6.2, I.C.E. Corp. v. Armco Steel Corp., 250 F. Supp. 738, 148 USPQ 537 (S.D. N.Y. 1966).

12.2.6.3, Dix-Seal Corp. v. New Haven Trap Rock Co., 236 F. Supp 914, 144 USPQ 57 (D. Conn., 1964); Cottier v. Stimson, 20 F. 906 (C.C. D. Ore. 1884).

12.2.6.4, Hamilton Laboratories, Inc. v. Massengill, 111 F. 2d 584, 45 USPQ 594 (6th Cir. 1940); Indiana General Corp. v. Lockheed Aircraft Corp., 249 F. Supp. 809; 148 USPQ 312 (S.D. Cal. 1966), rev'd on other grounds, 408 F. 2d 294, 160 USPQ 6 (9th Cir. 1968); Brian Jackson Associates, Inc. v. San Manuel Copper Corp., 259 F. Supp., 793, 151 USPQ 5 (D. Ariz., 1966), aff'd per curiam, 384 F. 2d 487; 155 USPQ 417 (9th Cir. 1967).

12.2.6.5, Hazeltine Research, Inc. v. Zenith Radio Corp., 239 F. Supp. 51, 144 USPQ 381 (N.D. Ill, 1965), rehearing denied, 401 U.S. 1015 (1971); Dix-Seal Corp. v. New Haven Trap Rock Co., 236 F. Supp. 914 144 USPQ 594 (D. Conn. 1964); Klein v. United States, 375 F. 2d 825 (Ct. Cl. 1967).

12.2.6.6, 35 U.S.C. § 103.

12.3.2.1, Woodbridge v. United States, 263 U.S. 50, 57 (1923); Levinson v. Nordskog Co., Inc., 301 F. Supp. 589, 163 USPQ 52 (C.D. Cal. 1969).

12.3.2.2, In re Appeal of Mower, 15 App. D.C. 144, 152 (1899) (Chief Justice Alvey).

12.3.3.1, Hazel-Atlas Glass Co. v. Hartford-Empire Co., 322, U.S. 238, 246, 61 USPQ 241, 245 (1944); General Excavator Co. v. Keystone Driller Co., 62 F. 2d 48, 50, 16 USPQ 269, 270–271 (6th Cir. 1932); Corning Glass Works v. Anchor-Hocking Glass Corp., 253 F. Supp. 461, 470, 149 USPQ, 106–107 (D. Del. 1966), modified on other grounds, 374 F. 2d 473, 153 USPQ 1 (3rd Cir.), cert. denied, 389 U.S. 826, 155 USPQ 767 (1967).

12.3.3.2, SCM Corporation v. Radio Corporation of America, 318 F. Supp. 433, 449, 167 USPQ 196, 207–208 (S.D. N.Y. 1970), citing U.S. Supreme Court authorities; cf. Earle R. Hanson & Associates v. Farmers Coop Creamery Co., 403 F. 2d 65, 70 (8th Cir. 1968); Precision Instrument Mfg. Co. v. Automotive Maintenance Mach. Co. 324 U.S. 806, 814–816, 65 USPQ 133, 137–138 (1945).

13. Fraud on Patent Office

13.2.1, 35 U.S.C. § 131; 35 U.S.C. § 122.

13.4.1, Kingsland v. Dorsey, 338 U.S. 318, 83 USPQ 330 (1949), Beckman Instruments Inc. v. Chemtronics, Inc., 428 F. 2d 555, 165 USPQ 355 (5th Cir-1970); Charles Pfizer & Co. v. F. T. C., 401 F. 2d 574, 579 (6th Cir. 1968), cert. denied, 394 U.S. 920 (1969).

13.4.2, Kingsland v. Dorsey, 338 U.S. 318, 319, 83 USPQ 330, 331 (1949).

13.4.3, Precision Instrument Mfg. Co. v. Automotive Maintenance Mach. Co., 324 U.S. 806, 818, 65 USPQ 133, 139 (1945); Beckman Instruments, Inc. v. Chemtronics, Inc., 428 F. 2d 555, 165 USPQ 355 (5th Cir. 1970); Monolith Portland Midwest Co. v. Kaiser Aluminum & Chemical Corp., 407 F. 2d 288, 160 USPQ 577 (9th Cir., 1969); Monsanto Co. v. Rohm and Haas Co., 312 F. Supp. 778, 793; 164 USPQ 556, 568 (E.D. Pa. 1970).

13.4.4, Beckman Instrumeents, Inc. v. Chemtronics, Inc., 428 F.2d 555, 165 USPQ 355 (5th Cir. 1970).

13,12,1, 208 F.Supp. 598, 135 USPQ 254.

13.17.4, SR v. BTL, appeal dismissed as being moot, 317 F.2d 491, 137 USPQ 497 (2nd Cir. 1963).

13.17.8, See SR v. BTL, appeal dismissed as moot, 317 F.2d 491, 137 USPQ (2nd Cir. 1963).

13.38.1, SR v. BTL, 208 F.Supp. 598, 605, 135 USPQ 254, 259.

13.39.15, Walker Process Equipment, Inc. v. Food Machinery and Chemical Corp., 382 U.S. 172, 148 USPQ 308 (1965).

13.39.16, Walker Process Equipment, Inc. v. Food Machinery and Chemical Corp., 382 U.S 172, 147 USPQ 404 (1965).

13.39.17, Beckman Instruments, Inc. v. Chemtronics, Inc., 328 F.Supp. 1132, 1138, 170 USPQ 466, 470–471 (W.D. Tex. 1971).

13.39.18, Cataphote Corp. v. De Soto Chemical Coatings, Inc., 450 F.2d 769, 772, 171 USPQ 736, 738–739 (9th Cir. 1971), cert. denied, 408 U.S. 929, 174 USPQ 193 (1972).

13.39.19, Waterman-Bic Pen Corp. v. W. A. Sheaffer Pen Co., 267 F.Supp. 849, 856, 153 USPQ 499, 504 (D. Del. 1967). See also Beckman Instruments, Inc. v. Chemtronics, Inc., 328 F.Supp. 1132, 1138, 170 USPQ 466, 470-471 (W.D. Tex. 1971).

13.39.20, United States v. Standard Electric Time Co., 155 F.Supp. 949, 952, 116 USPQ 14, 16 (D. Mass. 1957).

13.39.21, Eli Lilly and Co. v. Generix Drug Sales, Inc., 460 F.2d 1096, 174 USPQ 65 (5th Cir. 1972).

14. Other Patents and Patent Applications

14.11.6, Struthers Scientific and International Corp. v. General Foods Corp., 334 F.Supp. 1329, 1331–32, 172 USPQ 426, 427–429 (D. Del. 1971).

14.14.7, United States v. Gaxo Group, Ltd., 410 U.S. 52, 176 USPQ 289 (1973); Hawaii v. Standard Oil Co., 405 U.S. 251 (1972).

15. SR—IBM August 21, 1956 Agreement

15.6.1, 15 U.S.C. § 1.

15.7.1, 15 U.S.C. § 2.

15.25, 15 U.S.C § 1; Standard Oil v. United States, 221 U.S. 1 (1911); United States v. Socony-Vacuum Oil Co., 310 U.S. 150 (1940); Times-Picayune Publishing Co. v. United States; 345 U.S. 594 (1953); United States v. E. I. du Pont de Nemours & Co., 351 U.S. 377 (1956); United States v. National Lead Co., 63 F. Supp. 513, 66 USPQ 141 (S.D. N.Y. 1945), affd, 332 U.S. 319, 73 USPQ 498 (1947).

15.25.1, 15 U.S.C. § 1.

15.25.1.1, United States v. Line Material Co., 333 U.S. 287, 76 USPQ 399 (1948); Standard Oil Co. (Indiana) v. United States, 283 U.S. 163, 9 USPQ 6 (1931); Report of the Attorney General's National Committee to Study the Antitrust Laws (1955), at 242.

15.26, United States v. National Lead Co., 63 F.Supp. 513, 66 USPQ 141 (S.D. N.Y. 1945); aff'd, 332 U.S. 319, 73 USPQ 498 (1947); United States v. Timken Roller Bearing Co., 83 F.Supp. 284, 81 USPQ 28 (N.D. Ohio 1949).

15.36, United States v. E. I. du Pont de Nemours & Co., 351 U.S. 377 (1956); 16 Business Organizations, Von Kalinowski, Antitrust Laws and Trade Regulation, § 8.02.

15.40, 15 U.S.C. § 15; Zenith Radio Corp. v. Hazeltine Research, Inc., 395 U.S. 100, 161 USPQ 577 (1969).

17. 1961 Agreement of SR and BTL

17.2.8, SR v. BTL, 208 F.Supp. 598, 135 USPQ 254 (S.D. N.Y. 1962).

17.3.4, United States v. Line Material Co., 333 U.S. 287, 76 USPQ 399 (1948); Standard Oil Co. (Indians) v. United States, 383 U.S. 163, 9 USPQ 6 (1931); Report of the Attorney General's National Committee to Study the Antitrust Laws (1955), at 242.

18. 1965 Agreement of SR and IBM

18.9.2, United States v. Line Material Co., 333 U.S. 287, 76 USPQ 399 (1948); Standard Oil Co. (Indiana) v. United States, 383 U.S. 163, 9 USPQ 6 (1931); Report of the Attorney General's National Committee to Study the Antitrust Laws (1955), at 242.

19. Discriminatory Licensing

19.9.2, Peelers Co. v. Wendt, 260 F.Supp. 193, 151 USPQ 378 (W.D. Wash. 1966); Bela Seating Co. v. Poloron Products, Inc., 438 F.2d 733, 168 USPQ 548 (7th Cir.) cert. denied, 403 U.S. 922, 170 USPQ 65 (171); LaSalle Street Press, Inc. v. McCormick & Henderson, Inc., 445 F.2d 84, 170 USPQ 305 (7th Cir. 1971).

19.9.4, Laitram Corp. v. King Crab, Inc., 244 F. Supp. 9, 17–19, 146 USPQ 640-645–647, modified, 245 F.Supp. 1019, 1021, 147 USPQ 136, 137–138 (D. Alaska 1965); Peelers Co. v. Wendt, 260 F. Supp. 193, 204, 151 USPQ 378, 386 (W.D. Wash. 1966).

21. Section 7 of the Clayton Act

21.6.5, 15 U.S.C. § 18.
21.6.6, Act of October 15, 1914, ch. 323, § 7, 38 Stat. 731–32, amended 64 Stat. 1125–26, December 29, 1950; United States v. Philadelphia National Bank, 374 U.S. 321, 337–38, 340–41 fn. 18 (1963).
21.6.7, 15 U.S.C. § 18.
21.6.8, Highland Supply Corp. v. Reynolds Metals Co., 327 F.2d 725, 728 (8th Cir. 1964).

22. Statute of Limitations

22.2.5, 15 U.S.C. § 15(b).
22.3.1, 15 U.S.C. § 15(b).
22.4.1, 15 U.S.C. § 15(b).
22.10.1, 15 U.S.C. § 15(b).
22.10.2, 15 U.S.C. § 15(b).

23. Infringement of ENIAC

23.1.44, Graver Tank and Manufacturing Co., Inc. et al. v. Linde Air Products Co., 339 U.S. 605, 607, 85 USPQ 328, 330 (1950).
23.1.45, 35 U.S.C. § 283.

25. Declaratory and Injunctive Relief

25.2, 15 U.S.C. § 26; United States v. United States Gypsum Co., 340 U.S. 76, 87 USPQ 276 (1950); United States v. National Lead Co., 63 F.Supp. 513, 66 USPQ 141 (S.D. N.Y. 1945), aff'd, 332 U.S. 319, 73 USPQ 498 (1947).

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[illegible] Gulf & Western Corp. v. [illegible] [illegible] F. Supp. [illegible] (1967); [illegible] 287 U.S. [illegible] (D. [illegible] [illegible] Co. v. [illegible] F. Supp. [illegible] (D. [illegible] 1966).

24. Section 7 of the Clayton Act

[illegible] 15 U.S.C. § 18.

[illegible] Act of October [illegible] [illegible] Stat. [illegible] amended 64 Stat. [illegible] December 29, 1950; United States v. Philadelphia National Bank, 374 U.S. 321, [illegible] (1963).

[illegible] 15 U.S.C. § 18.

[illegible] Highland Supply Corp. v. Reynolds Metals Co., [illegible] F.2d [illegible] (8th Cir. 1964).

25. Statute of Limitations

[illegible] 15 U.S.C. § 16(b).

[illegible] 15 U.S.C. § 16(b).

[illegible] 15 U.S.C. § 15b.

[illegible] 15 U.S.C. § 16(b).

[illegible] 15 U.S.C. § 16(b).

26. Infringement of [illegible]

[illegible] Tank and Manufacturing Co., Inc. et al. v. Linde Air Products Co., [illegible] U.S. [illegible] (1950).

[illegible] 35 U.S.C. § 282.

27. Declaratory and Injunctive Relief

[illegible] 15 U.S.C. § 26; United States v. United States Gypsum Co., 340 U.S. 76, [illegible] (1950); United States v. National Lead Co., [illegible] F. Supp. 513, [illegible] (S.D. N.Y. 1945), aff'd, 332 U.S. 319, [illegible] (1947).